LIGHT RAILWAYS

AT

HOME AND ABROAD.

BY

WILLIAM HENRY COLE, M Inst C E

(LATE DEPUTY MANAGER NORTH WESTERN RAILWAY INDIA)

WITH PLATES AND ILLUSTRATIONS

LONDON

CHARLES GRIFFIN & COMPANY, LIMITED,

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PREFACE

LIGHT RAILWAYS postulate greater facilities for promotion, cheaper construction, simpler working and more lenient conditions generally than are applied to ordinary or standard railways, but, as pointed out in Chapter I, light and standard railways only differ from each other in degree and no sharp line can be drawn between them We are all feeling our way in the matter of light railways, and the treatment of a subject which is more or less unformed and undefined presents peculiar difficulties The late Mr Cornie L Thompson's *Catalogue of Books, Reports, Papers, and Articles relating to Light Railways*, 1895, was a most useful guide to a literature which is necessarily scattered and incomplete To sift this information, and to collect and arrange useful matter in a convenient and readable form was the result I aimed at

In Chapter II I have tried to give the general reader some idea of the principles which govern the classification of goods and the application of rates Passenger fares may vary directly as the mileage, but not, as a rule, goods rates Of all the factors which affect the cost of goods service, distance is often the least important It will usually pay a railway better to carry properly packed foreign produce right through from port to market than small home consignments picked up at intermediate stations Not only, however, is it generally impracticable to lower local rates to the level of import rates, but attempts to satisfy the home producer by raising the import rates have sometimes merely resulted in forcing the foreign produce to find a cheaper way to the market by sea The British agriculturist's ultimate remedy lies, not in requiring the railways to "boycott" the foreigner, but in adopting better methods of packing, in combining to make up larger consignments, and in the development of light railways under the Act of 1896 Why—as Mr W M Acworth once asked—if light railways are useful to foreign farmers, must they be useless to English farmers? In the writing of this

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chapter I am indebted to Acworth's *The Railways and the Traders*, to Grierson's *Railway Rates*, to Hadley's *Railroad Transportation*, and to a course of three lectures on *Railway Management* (Calcutta, Bengal Secretariat Press, 1896) delivered at the Sibpur Engineering College by S Finney, Manager (under whom I held the post of Deputy Manager) of the Eastern Bengal State Railway

What other European countries have done towards the development of light railways has been briefly described in Chapters III–VI No system, in regard to its organization and results, offers to those interested in light railways so instructive a field for study as that of Belgian Light Railways They owe their development to the foundation in 1885—*with the express object of enabling agriculturists to compete with foreign producers*—of the National Society of Local Railways, which holds the monopoly of light railway concessions, determines the contributions of the State, provinces, communes, and private individuals (a small proportion), and distributes the profits Under the Act of 1896 we have, at last secured equal facilities and as simplified a procedure, but, as our Light Railway Commissioners simply deal with applications made to them for an order authorizing a light railway, State aid is practically unknown, financial assistance from local authorities is seldom sought, and private enterprise is still the mainspring A close parallel has been traced in some detail between the cost of Belgian Light Railways and light lines on the same (metre) gauge in India In France the direct control of the light railways is placed in the hands of the Prefects, and the tendency is for the departments to construct the lines and to lease the working of them This raises the question of a traffic formula which shall induce the lessee to work the light railway in the interests of the public, by making the amount of his subsidy depend upon his doing so The Belgian and Noblemaire's formulæ, Considère's formula, and Colson's modification of it come under brief review The consideration of these and of MM Considère's and Colson's controversy on the claims which light railways have, not only upon local but upon national support, as well as upon the most generous treatment by the main lines which they feed, cannot be without interest, and even practical value, to all who are interested in the light railway question The development of Italian tramways (which are—as in Belgium, France, and Holland—light railways on roads) shows that it is far more effective, in the long run, to offer private enterprise a fair field, unhampered by harassing restrictions, than to afford direct pecuniary assistance in the form of Government subsidies In Prussia the pro

vincial and district authorities, but not the Central Government, may support the undertakings of other local bodies or of private persons. Light railways on roads are far more frequent on the Continent than they are likely to be in England.

In our Colonies and in the United States, uniform adherence to a standard of perfection has not been required, and, consequently, the necessity of making light railways a distinct class seldom arises. As will be seen in Chapter VII, these countries offer suggestive examples of the cheap construction of pioneer lines in undeveloped districts.

Facilities for the acquisition of land, and the early recognition of light-railway principles, wherever the utmost economy was essential, have already added a considerable mileage to our Indian railway system (Chapter VIII). The "Branch Line Terms of 1896" and the near prospect of a stable exchange should attract British capital to the development of light railways in India.

Unlike England and Scotland, Ireland (Chapter IX) is no stranger to State aid, and, apart from mere figures, the construction of light railways with State assistance has been a great boon to poor and remote districts. The Irish Act of 1896 is in line with the English Act of the same year.

Chapter X devotes a brief space to traction engines, road locomotives, and other means of road transport which offer themselves as possible alternatives to light railways in certain cases, and their recent relief from certain disabilities which restricted their use has been described.

The interpretation of the Light Railways Act of 1896 is dealt with in Chapter XI.

The notion that a light railway must be a narrow gauge railway is far too common. Light axle loads and low speeds, not gauge, are the first conditions of cheap construction and economical working. Gauge is quite a secondary factor, the effect of which is very often exaggerated by the advocates of narrow gauges. Its influence on the cost of different items of expenditure is discussed in Chapter XII. Unless there are very special reasons to the contrary, light railways in England—short in length and making contact with the main lines—should be on the 4 ft. 8½ in. gauge. It is many years too late to wish that in India 4 ft. 8½ in. were the standard gauge, with the 2 ft. 6 in. gauge to fall back upon for those light railways which could not or need not make physical connection with the main lines in order to carry standard gauge goods stock. *All the world over there ought to be two gauges only, the 4 ft. 8½ in. and the 2 ft. 6 in.*

Chapter XIII on "Construction and Working" and Chapter XIV o "Locomotives and Rolling Stock" (and this explanation applies to th other chapters also) were not designed to form portions of a technic text book on 'Light Railways' That would necessarily include s much information regarding the construction, equipment, and work ing of ordinary, as well as of light railways—information regardin which is within the knowledge of railway engineers and within th reach of all—that I have simply endeavoured in those chapters t suggest or to recall the various details which admit of simpler an more economical treatment in the case of light railways In n branch of expenditure is there more scope for economy in working tha in the organization of the revenue staff—by employing cheaper se vants than would be required on ordinary railways by making th duties of the subordinate staff interchangeable, and by combining th supervision and administration of several departments under one hea —and yet, in Chapter XIII this important question is confined to o (the concluding) paragraph The conditions of light railway worki must vary so greatly that suggestions for reducing establishme charges are best sought and considered in connection with the partic lar systems where such economies have actually been applied (see *In l* —"Economies in Construction and Working)

More precise illustrations of economical construction, equipme and working are given in Chapter XV (on 'Light Railways England, Scotland and Wales) which contains short studies of thr light railways constructed before the Act—the Wisbech and Upw Tramway, the Three Horse Shoes and Benwick (Goods) Line, and th Easingwold Railway Through the kindness of Col G F O Boughe R E, C S I (one of Her Majesty's Light Railway Commissioners I have been able to bring my information regarding light railwa which come under the Act of 1896 as nearly up to date possible

Finally, my thanks are due to the General Manager, Locomoti Superintendent, and Mr Sherlock of the Great Eastern Railway, the Honorary Secretary of the Easingwold Railway, to Mess John Fowler & Co, to Messrs Kitson & Co, to the Leeds Forge C to Mr Everard R Calthrop, to the representatives of the Colonies *London, to Mr A S Jameson (Locomotive Superintendent, F B S R* India), and to many others, who have kindly placed information my disposal

W H C

January 1899

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LIGHT RAILWAYS AT HOME AND ABROAD.

CHAPTER I

DISCUSSION OF THE TERM "LIGHT RAILWAYS"

Definitions of Terms.—The subject of light railways may be compared to a country which has no fixed frontiers, or to those Arctic lands whose northern limits are still unmapped. The reader's first and natural demand for a definition of the term "light railways" must be frankly met with the disappointing reply that a hard and fast definition, at once concise, exact, and comprehensive, is not forthcoming.

It is not easy to determine the exact point of divergence of light from *standard railways*. One is not necessarily divided from the

or the Decauville Company supply—are light railways is obvious, but they represent a limited and extreme type.

Nor does the length or location of a line establish the difference between a light and a standard railway, for a *pioneer railway* may extend for two or three hundred miles and occupy a main trade route—until the pressure of a growing traffic compels its replacement by a more substantial system—in a new or poor country, where the choice lies between a cheap light railway and none at all. In richer and

more prosperous countries, however, *not only* the main, but many of the branch and *feeder railways*, are already of the standard type, and the development of light railways will take place later, serving the

have had certain sections of their lines classed as local railways and brought under the lenient conditions of the law of 1878, and, although this is less likely to occur in England, we already have reason to conclude that future branches and minor extensions of our great systems will frequently be made under the provisions of the Light Railways Act of 1896

If we go abroad—as we must in our study of the light railways question—we find the same merging and overlapping of terms, and a similar difficulty in determining their precise limits and in suggesting English equivalents Thus, the Belgian system of light railways consists of *chemins de fer vicinaux*, which are generally laid on district or parish roads, and may, perhaps, be called by us district railways The French speak of *chemins de fer d intéret local* or branch lines, as distinguished from *chemins de fer d intérêt general* or through lines Other terms are *chemins de fer affluents* or feeder lines *chemins de fer secondaires* or second-class lines, *chemins de fer d ordre inferieur* or third-class lines, *chemins de fer economiques* or cheap lines, and *tramways*, a term which is very differently applied in one country and another. These lines may, or may not, be *chemins de fer a voie etroite* or narrow gauge railways, of any gauge less than the standard 4 ft $8\frac{1}{2}$ in, from 1 m 20 cent (3 ft 6 in), first introduced in France in 1865, to the more general 1 metre (3 ft $3\frac{3}{8}$ in) and smaller gauges, which are comparatively unfamiliar to us in England, but frequently adopted on the continent, in India, in our colonies and elsewhere.

special departure siding These tram-trains or way trains stop at

main lines,

... of secondary lines, *Nebenbahnen* or branch lines, *Kleinbahnen* or light lines, and *Localbahnen* or local lines

a tram-

ld still

a line

may use the way except when trams are passing, it implies, in fact, joint and not exclusive occupation of the space covered by the tramway. Accordingly, the space between the rails, as well as outside of them,

flush with the head of the rail,
the tram wheels Such a con-
Tramways Act of 1870, but it
is not invariably carried out The Wisbech and Upwell Tramway, for example, although laid on the side of a public road, has, with one

the head of the rail But the road is not so made up because the road authorities did not, after all, insist upon it, and the check rail remains redundant, for the track is ballasted with stone or gravel in the usual way The line looks like an ordinary railway, but it is officially classed as a tramway This tramway—built, worked, and owned by the Great Eastern Railway Company—might this year have been built under the Light Railways Act of 1896 instead of the Tramways Act of 1870 Two further distinctions between railways and tramways are generally recognised, the latter pick up and set down passengers by the wayside, and they are not, as a rule, supposed to carry goods

other motive power, might be described as tramways, but the term cheap or light railways (*chemins de fer economiques*) should be substituted for steam tramways in the case of all lines of rails laid wholly or partly upon roads, and designed to connect different centres of population This agrees with our restricted use of the term "tram

where no compulsory
Light Railways Act
the construction and
working of light railways was mainly contained in the Railway Construction Facilities Act, 1864 [27 & 28 Vict cap 121], and the Regulation of Railways Act, 1868 [31 & 32 Vict cap 119, Part V]

Sir Douglas Fox,* more than thirty years ago, understood by light

* "Light Railways in Norway, India, and Queensland," *Min Proc Inst. C E*, vol xxvi, 1866 67.

part made only of such strength as to carry loads represented by the rule that no pair of wheels should be allowed to have more than six tons upon it This would enable those lines to carry the rolling stock of all other railways of similar gauge, with the exception only of the locomotive ' He instanced the railway system of Norway as an example, being "on the light principle, and of the 3 ft 6 in gauge" Above high water level the superstructure of the bridges (including the Warren trusses) was of timber, the station buildings were of timber, the rails weighed 37 to 40 lbs per yard, the sleepers, laid 2 ft. 6 in. apart, centre to centre, were of creosoted pine, with the round side up, and adzed to increase the bearing surface, and the cost was £6000 per mile

plied Although the example quoted is of a narrow gauge line, his *definition is independent of any limitation in that respect*, while his careful provision for the use of rolling-stock belonging to heavier lines absolutely demands continuity of gauge The scope of his definition would have been wider if he had abstained from prescribing a maximum axle load

Apart from the detail of gauge—in regard to which his opinions are very decided—Sir John Wolfe Barry's presidential address* to the members of the Institution of Civil Engineers, on the 3rd of November 1896, contains a freer description of what English light railways should be generally "So far as works are concerned," said the

motive which need not be heavier for the wider gauge, while the

railway, then, in regard to length and location may occupy, as a temporary or pioneer line, an extensive main route capable of future development, or it may form a short feeder to an existing system; or it may complete minor connections, or it may be a purely local and independent line of short length It may be laid on a road, if land outside is costly, and the width, grades, and bends of the road are suitable It may be of standard or less gauge, according to circumstance But, economy being essential, we shall expect to find

* *Vide Proc Inst C E*, vol. cxxvii of 1897

a single line, a lighter rail, slower speeds, lighter axle loads, and—in regard to staff, brakes, block working, road crossings, signalling, interlocking, station arrangements etc.—less stringent requirements than are demanded on standard railways. In addition to exceptional economy in construction and in working, we shall require a cheaper and simpler legal and parliamentary procedure than that prescribed for standard railways, facilities of promotion, cheap land, and assistance—possibly financial—from individuals, from local bodies, and, in special cases, from the State.

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sort
and to the Board of Trade to decide the claims of each project, as it comes before them, to be dealt with under that Act.

A complete definition covering all the ground, if not impossible, would be too complicated for ready application to every case; a partial definition would frequently be misleading. While, however, we lack a definition at once concise, exact, and comprehensive of the term "light railways," the Commissioners and the public are well able to form a very fair opinion on the claims of any proposed line—taking into account its objects, its position, its construction, its equipment, the nature and extent of its traffic, and its working economies—to be considered and treated as such. In the differentiation of light railways from standard railways, therefore, there appears to be no ultimate difficulty; and to their practical association there should be no serious obstacle.

We may say, roughly, that a light railway might be (1) absolutely local and independent in its entertainment of traffic, or (2) contributive to an existing main line, or (3) competitive with a main line. If the first condition obtains no main line has any direct concern with the light railway; if the second, the main line should encourage the branch in the most generous manner; and the third condition should never be allowed to take effect—in fact, we may safely assume that the Commissioners will never permit the Act to be applied to the prejudice of an existing standard railway.

As the differences between a standard and a light railway are not in kind but in degree, and both are intended to discharge identically the same functions, light railways will have to be worked, not as benevolent institutions, but on the same business principles as standard railways. Light railways have been called for mainly in the agricultural interest. It is hoped that they will place the British producer on at least equal terms with his foreign competitor. Their success will largely depend upon his intelligent co-operation, and also upon their being allowed a very free hand in the fixing of rates.

The next chapter will be devoted to a brief consideration of the principles which determine the application of rates, the relations of railways generally to agriculture, and the demand for light railways as feeders to tap the country districts

Other methods of transport, not on rails but on the ordinary surface of the public road—by means of road locomotives, traction engines, auto-motors, etc —call for some notice, because they are often capable of performing the very services required of a proposed light railway, and later on, therefore, a brief chapter will be devoted to them

CHAPTER II.

ENGLISH RAILWAYS, RATES, AND FARMERS

Commission under Act of 1873—Railway and Canal Commission under Act of 1888—Provisions of the Act of 1888—Statistical returns—Maximum rates—Undue preference—Competitive rates—Import rates and the British farmer—

Development of Traffic Routes.—It has never been considered in England to be the business of the State to initiate, plan, and construct the roads and canals in accordance with a regular and comprehensive system, such as that which, in France, originated with Colbert and was perfected by Napoleon Private enterprise has, from the first, determined the development of our internal communications

English roads seldom followed the best alignment, and were often steeply graded. These defects render them peculiarly unsuitable, in many instances, for the laying of light railways upon them The fault did not necessarily lie with the surveyor, for his choice of route was limited by the necessity of skirting the boundaries of fields and estates belonging to landowners whose privileges would not yield to public interests The canals, however, offered so efficient a means of communication, and commanded such powerful influence, that they constantly presented the most formidable opposition to the introduction and development of railways But time brings its revenges, and the position was exactly reversed when the Manchester Ship Canal came to be made

The most striking features of
vehicles with flanged wheels upon
trains, consisting of such vehicles,
220 years ago coal wagons were drawn on timber rails by horses A century later iron rails, nailed on wooden sleepers, were laid at the Sheffield colliery. In course of time, plate rails of cast-iron were replaced by edge rails of malleable iron, and the wheels were flanged. The history of modern railways has been dated from the construction

of a line between Wandsworth and Croydon, which was sanctioned in 1801, to be worked by horse traction * Then followed Huskisson's decisive defeat of the canal opposition, the sanction of the Liverpool and Manchester Railway in 1820, and the completion of the Stockton and Darlington line in 1825 But the most important starting point of modern railway progress must be referred to the success of Stephenson's locomotive, the "Rocket"—with its blast pipe, multi tubular boiler, and springs,—in 1829 The contrast between Stephenson's engine and the modern locomotive, in regard to power, weight, and speed is, indeed, sufficiently striking but it is possible that we are about to make a still more startling development by the substitution of electricity for steam as the motive power And while, in light railway work, we revert to rails and axle loads lighter than those that prevailed in early days, it is not unlikely that we shall discover in so modern a motive power as electricity the best and cheapest for our purpose under certain conditions

Comparing our modern steam engine with that of sixty years ago, we find that, with a steam generating surface three times as great, and nearly four times the steam pressure, its power is ten fold greater Increasing axle loads and higher speeds have required the adoption of heavier rails, and these have for many years been made of steel instead of iron English passengers accept the speed comfort, and safety with which they travel as a matter of course The rapid succession of fast trains is due to the laying of double lines and the perfection of the block system Safety appliances have been multiplied almost to excess The development of through routes has been remarkable In all the advantages of modern travelling the third class passenger shares, for his paying value has long been recognised It is now not merely economical, but almost fashionable, to travel third class, and third class accommodation is provided on nearly every train The convenience and speed of the goods service are still more notable Terminal facilities have been so perfected that the conveyance of goods is almost literally from the door of the producer to that of the consumer, and in regard to collecting, loading, unload

quoted from the *Railway Returns for* 1896 —

Capital—	
Ordinary,	£380,073,903
Total,	1 029,475,335
Length of line open—	
Double or more,	11,589 miles
Single,	9,688 „
	21,277 miles

* Hadley's *Railroad Transportation*, p 19

Receipts—	
Passenger,	£39,120,865
Goods,	46,175,335
Miscellaneous,	4,822,922
Total,	£90,119,122
Working expenditure	50,192,424
Net earnings,	£39,926,698
Locomotive	18,956
Carriages, wagons, trucks, &c.,	692,751

In Messrs R. Giffen and F. J. S. Hopwood's Report * to the Board of Trade, the following figures are given —

Percentage of net earnings on capital,	3 88
Dividend paid on ordinary capital,	4 29
Per train mile—	
Receipts from traffic,	57 93d
Expenditure exclusive of harbour, &c., expenses,	32 41d
Net earnings	25 52d

And the expenditure per train mile is thus distributed —

Maintenance of way,	5 54d
Locomotive power,	8 81d
Rolling stock,	2 90d
Traffic expenses,	10 56d
General charges,	1 48d
Rates and taxes	2 13d
Government duty,	0 19d
Compensation—	
Personal injuries	0 08d
Damage to goods,	0 18d
Legal and Parliamentary expenses,	0 20d
Miscellaneous	0 34d
Total working expenditure per train mile,	32 41d

Conditions Regulating Traffic Rates —Passenger fares in England compare very favourably with those of other countries. A passenger in an ordinary American car may be charged an average of 1d. per mile, in an English third class carriage somewhat less, but our first

* Herapath's *Railway Journal*, 29th October 1897

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* Herapath's *Railway Journal*, 29th October 1897

and second class fares are higher than those which include the use of the American special cars Continental fares, taken with their draw backs and our advantages—*e g*, our provision of third class accommo dation on almost every train, and allowance of 60 lbs of luggage free of charge while the barriers, formali luggage, which are sufferer rable in England Indian fares are, of course exceptionally low A third class fare of $\frac{1}{6}$d per mile is the highest that can be levied, and could only be levied, in a country where the wages of the railway *employe* and of the ticket buyer are extremely low Neither the wages nor the fares can be compared with ours, for in India the necessaries of life are cheap and the conditions are easy to the native, however costly the former and difficult the latter may be to the Englishman in India

With our passenger carriages although they may be only 7½ feet wide, as compared with 9 feet in America, we may well be content The third class passenger now a-days is provided with roomy and comfortable compartments, and finds a dining car attached to long journey trains Our goods stock are more open to foreign, and especially to American, criticism If we have utterly discarded the defunct stage coach as a pattern for passenger carriages, our goods wagons—these critics say—are still little better than the colliery trucks placed upon the earliest railways An Indian standard gauge covered wagon, taring only 7 tons 10 cwts, will take a load of 16

in stock is chiefly due to the difference in conditions If Indian and American railways did not build for a higher ratio of paying to dead load they would never bring their wheat to the English market Full train loads of full wagon loads are of the first importance On the contrary, short lead, light loads, and rapid transit are essentially characteristic of English goods traffic Our wagons have to be moved about in yards and sidings by horse power, and an 8 ton truck is quite as much as a single horse can fairly manage There is much to be said, therefore, for preferring 8 ton stock, and 10 tons may be acity not that ried

The division of receipts between one railway and another is based upon so low a minimum load as 1 ton Economy of time rather than of load is the first *desideratum* An express goods train may slip or pick up a wagon at a station, but it has no time to spare for dealing with mixed consignments in one wagon Where a wholesale traffic in wheat, hog products, etc is offered for haulage hundreds of miles from the interior to the port, full trains of fully loaded wagons —specially designed for a high percentage of paying to dead load—

are essential to economical working But in England the ... largely made up of small consignments of a high class ... articles, mixed goods, &c, and speed and convenience are ... importance than economical loading A few figures will ... different the conditions of traffic in one country and another ... In England the goods ... 51 2 per cent of the ... per cent, yet no less ... conveyance of ... minerals and general merchandise, while 42,284 carriages are ... for the passengers In India the goods receipts make up 60 6 per cent of the whole, as compared with 36 2 per cent from passengers but 49,524 standard gauge and 27,424 metre gauge vehicles are ... for the goods, while 7078 standard gauge and 4903 metre ...

it is convenient to charge them on a mileage basis The classification of goods, on the other hand, is most complicated English ... rates generally include collection and delivery, so that ...

Act, and the new railway Acts were framed on very much the same lines as canal Acts Railways were regarded merely as a new form of highway, upon which traders paying certain tolls would run their own trucks, just as the users of roads loaded their own wagons or users of canals carried their cargoes in their own barges Railway charges accordingly took the form of tolls, and were so scheduled in the Acts The supply of trucks by the traders instead of by the railways still survives, and the theory of equal mileage rates—or the application to the same kind of goods of the same charge per mile throughout, a theory natural to a system of tolls—is not yet wholly ...

... may be assigned to terminals, is shown by Mr A M Wellington's statement that they account for three fifths of the whole rate of goods from Chicago to New York *

The equal mileage basis of rating was thrown out by the Joint

* *Railway Location* by A M Wellington, p 820

Committee of 1872 and by the Royal Commission of 1876 on the ground that it "would prevent railway companies from lowering their fares and rates so as to compete with traffic by sea, by canal, or by a shorter or otherwise cheaper railway, and would thus deprive the public of the benefit of competition, and the company of a legitimate source of traffic" It would, of course, be grossly unfair to the railways, but it was rejected in the interests of the public

Any endeavour to adopt actual cost of service as the basis of charge would be disastrous to the development of business Fortunately, the cost of service cannot be determined, and, even if it could be determined, it could not be applied and, even if it could be applied, the great bulk of goods traffic could not pay it No one could fairly distribute the exact share of movement, station, clerkage, terminals, maintenance, and other expenses, or of interest on capital, which each item of traffic should bear

Speed, bulk, risk, trouble, quantity, regularity of shipment, back loading—all these are at least as potent factors in the cost of transportation as mere distance and, in considering a rate, the experienced manager thinks of every detail For all practical purposes he can reckon up the cost of hauling a train over a certain section He may consider that 13d a mile will about cover the cost of working a certain train (an Indian railway manager might put it at Rs 1 a mile) and thus decide whether it is worth his while to keep this train on or to take it off What he wants is to increase his net revenue If an expansion of business offers which will increase his gross earnings faster than it will increase his working expenses, he will be inclined to undertake it It may not pay its full share of the fixed charges—expenses which must be incurred on the minimum of traffic, such as the irreducible permanent establishment and interest on capital—but, whatever it brings in, over and above the actual cost c

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rates, a survival of the "toll" system and absolutely destructive to long lead traffic, and the "cost

unit which is variable, indeter

at the only practicable solution,

The rule was thus stated by

Company of France) —"In the matter of transport tariffs there is only one rule, viz, to ask of merchandise all it can pay, any other principle is no principle" This, as has repeatedly been explained, does not mean charging more than the traffic can bear, nor does it mean lowering the rate after the ultimate expansion of traffic in a particular commodity has been secured In the very early days of competition between railways and canals it was supposed that only goods requiring rapid conveyance would be able to bear charges high enough to pay interest on undertakings so costly as railways The

* *Railway Location*, by A M Wellington p 726

adaptability of railway rates to low class traffic was not immediately recognised The prosperity of railways is founded on the rule of trade which seeks for profit on even the most costly plant and machinery in quantity of output rather than in high prices, and the maximum traffic in any commodity is obtained by lowering the rate to what the traffic will bear

The first application of this principle is seen in the "General Classification of Goods" which is based partly upon the bulk and other features but mainly upon the *value* of the goods A few examples may be quoted

Unless otherwise provided the rates for goods in Classes 1 to 5 include collection and delivery within the boundaries prescribed by the companies at the various places The rates do not include collection or delivery of any article weighing more than three tons, nor of any article which by reason of its shape or dimensions, cannot be conveniently and safely carted on a vehicle ordinarily used for general merchandise

The highest rates are applied to goods of Class 5, such as live poultry, *furniture in cases*, etc

Eggs in hampers or sieves (subject to a lower rate if booked at owner's risk), dead poultry, furniture in van bodies, etc, are assigned to Class 4

In Class 3 we find eggs in boxes or crates, cotton goods in bales or boxes milk apricots cherries raspberries, strawberries, etc

To Class 2 belong cherries, raspberries, and strawberries in tubs for jams etc

Hay, not compressed to a certain density, comes in Class 1, so do herrings cod, ling, and—if determined by measurement—timber Potatoes in casks, if in less than two ton lots, are included in Class 1

But potatoes in casks in two ton lots are more leniently treated in special Class C, and firms may sometimes obtain rebates on larger quantities. In this class too, we find hay machine pressed to a minimum of 2½ tons per truck timber reckoned by actual machine weight, carrots, cabbages, wheat, vetches, oil seeds, rice, oats, malt, flour, beans barley, and other grains Class C is applicable to consignments of two tons and upwards

Classes B and A are applicable to consignments of four tons and upwards

In Class B are included manure in bulk, common and fire clay bricks, roofing tiles, mangel wurzel in bulk for cattle, etc

Limestone in bulk, fire clay, coke, coal, etc, are placed in Class A, and for these the lowest rates are quoted An additional charge is made for the provision of wagons for Class A goods

Articles exceptional in bulk, length, or weight, or insecurely packed, specie, bullion, gold or silver plate, precious stones, etc, are carried by special arrangement

If the quoted rates include cartage rebates are given for cartage done by the shipper Concessions may also be granted in such matters as warehouse rent, siding rent, demurrage, etc

To enable long-distance traffic to reach the market, differential rates may be applied, so that the charges shall increase much more slowly than the mileage Thus if the rate is cumulative, we may pay, for the carriage of 14 lbs of farm and dairy produce, 6d for any distance not exceeding 50 miles, 7d for any distance not exceeding 100 miles, and so on, in which case we are charged 6d for the first 50 miles, and 1d for the next 50 miles Telescopic rates of this sort do not overlap But when a certain rate is charged per ton per mile for any distance not exceeding 100 miles and a lower rate for any distance greater than 100 but not exceeding 200 miles, and so on—the rate being on a graduated scale—the cost of carriage over a greater distance may be less than that over a shorter distance It is as if a tradesman's offer of "making a reduction on taking a quantity" took the form of charging a customer 1s a piece for 100 articles or 9d a piece for 120 To correct this overlapping, the rate might be raised *forward* by not charging less for the greater than for the shorter distance, or the rate might be lowered *backward*—on what the Americans call the 'short-haul' principle—the rule being that the charge for the lesser distance or weight shall not exceed the charge for the greater In one case a forward, in the other case a backward, group rate is introduced The latter is the differential rate generally applied in India.*

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authority will be admitted, but for very special reasons it would be grossly unjust if the exercise of this control prevented railways from earning a fair profit on their whole business Their capital is not, like that of bankers or shopkeepers, transferable to some other sort of business, but is permanently sunk in the provision of one thing only—the means of transportation—which, if not bought, is useless for any other purpose, and, if bought, must be paid for at a proper price On the other hand, it must be conceded that railways—the destroyers of local and physical monopolies—are themselves partial monopolists The inevitable quotation may as well be made here as elsewhere, "Where combination is possible," said George Stephenson, "competition is impossible" Rate cutting was abandoned as a weapon not merely murderous but suicidal in its effect By one means or another—by amalgamation, by combination, by agreements to maintain rates, and by pooling the field, the traffic, or

* Appendix vi —*Goods Tariff, N W P , India*, para 43

speed, convenience, and facilities of every kind, to the great advantage of the passenger and trader, but it is only true, and partially true, as between one railway and another Admitting, however, that railways are partial monopolists, we must also acknowledge that, to a limited extent, they are public corporations

Mr A B Stickney (President of the Chicago Great Western Railway Company) observed* that a railway is neither a private nor a public corporation, but what he calls a *quasi* public corporation The power and duty of providing highways is exclusively and inalienably vested in the Sovereign or Government This implies the right and duty of the latter to control rates. Rates are not a *quantum meruit* for specific services, but tolls A toll is a tax Therefore, railway rates are taxes, and all the rules applicable to the levy of taxes apply to the levy of railway tolls or rates

We shall venture to dissent from nearly all these statements which are included in Mr Stickney's argument It is not necessarily the business of the State to make highways, a people like the English 'e by private enterprise or local Rates *are* a "*quantum meruit*" are not toll, and, therefore, they are not taxes With Mr Stickney's conclusion, however, that it is the duty of a railway so to raise or lower rates as to produce the largest revenue we readily agree

As providers of a public use, railways claim such rights as the compulsory acquisition of land and other property As private corporations, they resent the interference of the State in the details of their business Whichever position they take up, there are drawbacks as well as privileges to be accepted Mr Stickney's term—*quasi* public corporations—is not inapt, and there must be over such bodies some sort of controlling and arbitrative power exercised by Government, both in respect of rates and other matters Such power was vested in the Railway Commissioners by the Act of 1873, and trans the Act of 1888 the Regulation of to take joint action efine their liability for damage or los ensure publicity o body nor a court the complaint of the demand of one company for running powers over the lines of another, but, if a point of law arose, the case had to be stated for

* *Bulletin of the International Railway Congress* vol x, July 1896

submission to a court of law It lay with the Commissioners, however, to decide whether the question at issue was one of fact merely, or one of law

By the Railway and Canal Traffic Act, 1888 [51 & 52 Vict cap 25], the jurisdiction and powers of the Railway Commissioners were transferred to their successors, the Railway and Canal Commissioners This new Commission consists of two appointed and three (for England, Scotland, and Ireland) *ex officio* Commissioners To them complaint may be made by certain local authorities or by any association of traders or freighters, or chamber of commerce or agriculture, recognised by the Board of Trade They may hear and determine questions of traffic facilities, undue preference works for public accommodation, the legality of tolls, rates or charges the apportionment of expenses between a railway company and applicants for works, etc

Part II of the same Act requires every railway company to submit to the Board of Trade a revised classification of merchandise traffic, and a revised schedule of maximum rates and charges applicable thereto These must declare the nature and amounts of all terminal charges proposed to be made in respect of each class of traffic, and such terminal charges must be justified by 'expenditure reasonably necessary' The classification and schedule, as determined by a Provisional Order of the Board of Trade, require confirmation by an Act of Parliament Provisions are made for through traffic and through rates, and the apportionment of the latter The burden of proving that a difference in rate or of treatment, as between one trader and another, is not an *undue preference* is thrown on the railway company, but the Court or Commissioners must consider whether the difference in rate or treatment is necessary for the purpose of securing the traffic in the interests of the public Group rates are expressly permitted, provided that they do not create an undue preference and the distances are not unreasonable The Board of Trade may deal with complaints of unreasonable rates of charge, and may report to Parliament upon them Railways must in their returns furnish such statistics as the Board of Trade may require Every company must allow any person to inspect the classification table, or buy copies, with the authorised schedule of maximum charges The railway must disintegrate a rate, if so required by any interested person, and distinguish the charge for conveyance from terminal or dock charges Rates are to be open for public inspection

Part III applies similar provisions to canals, and Part IV perpetuates the Act of 1873, and deals with miscellaneous matters

Of the questions referred to in the Act of 1888, a few call for further remarks, *e g*, the statistics contained in the returns, the maximum rates and charges, and undue preference

The Commissioners have not such a volume of statistics at their disposal as are demanded in other countries English railway companies will tell you how many passengers and how many tons of goods

they carry, their gross receipts from passenger and goods traffic, the r working expenses, net receipts, details are a practical expression In the average cost of hauling a ton of goods or carrying a passenger one mile, in the average number of tons in a train, in the average load of a goods vehicle, and in 200 similar items of statistics which afford the Government of India an oppo other, and take no in t the average, and work it out as a curious calculation, but I do not see how it would enable you to get more profit, or to reduce your expenses, or to increase your trade" The method of the railway manager is to deal with each case as it crops up, and this is more or less true also of the Railway and Canal Commission, and of English railway legislation Great Britain has, says Professor Hadley,* "settled down on the policy of specific laws for specific troubles" There can be no better policy, it is simple, practical, and Anglo Saxon

In discussing the Light Railways Act of 1896 later on, we shall notice that it requires a provision to be inserted in the Order, fixing the maximum rates and charges for traffic It has often been said that the statutory maxima are so much higher than the existing charges that they are practically inoperative The present Schedules probably are not so lenient, and in some cases the maxima may have the effect of unduly forcing down the rates

The burden of proving that a difference in rate or treatment, as between one trader and another, is not undue preference is laid upon the railway If a special rate is given to one trader, it must be given to all traders under the same conditions, but it cannot be condemned as preferential if it is the result of fair competition We have seen in

offered was more conveniently and cheaply handled When, however, it was proposed, at the session of the Joint Select Committee in 1891,

small traders and establish the monopoly of a few great traders. There was the economic objection that such consignments cost just as much as others to work, conduct, and convey And there was the practical objection, that nobody could say what was a wagon load or

* *Railroad Transportation*, by Arthur T Hadley

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other experts, opposed the introduction of rates which they considered *unduly preferential to the large consignor* There was the moral objection to a principle which, in its application, would destroy the small traders and establish the monopoly of a few great traders There was the economic objection that such consignments cost just as much as others to work, conduct, and convey And there was the practical objection, that nobody could say what was a wagon load or

* *Railroad Transportation*, by Arthur T Hadley

a train load As Lord Balfour of Burleigh observed, "it seems to us no more easy to say what are the contents of a truck, or what can be hauled in a train, than to specify any quantity by saying that it is as big as a lump of chalk, or as long as a piece of string the conditions vary so much" Differential rates are, however, quoted for consignments of certain goods offered in convenient quantities, such as 2 ton and 4 ton lots

Again, those who sweepingly assert that railways are monopolists cannot be aware of the extent to which water competition—by sea coast by navigable river, or by canal—affects railway rates These have to be lowered towards the canal rates at certain places, and frequently give rise to complaints of undue preference The railways are, however, held to be justified in quoting competitive rates at competitive points Thus, a canal rate for grain of 4s 6d or 5s might compel the Great Western Railway to quote 5s 10d between Gloucester and Birmingham, although the railway maintained a higher rate, say 6s 8d, between Cheltenham (a nearer but a non competitive station) and Birmingham

Import Rates and the British Farmer—But of all competitive rates, those most bitterly attacked—especially by the British agriculturist—are the **import rates** which bring to our market grain, wool, cattle, poultry, meat, dairy produce etc, from abroad The railways push their way to the ports, establish their wharves, link themselves directly with the sea borne traffic, and, by quoting lower rates than they offer to internal traffic, secure the carriage of imports which, otherwise would go to London by sea

Import rates are the natural result of competition and free trade Railways can scarcely be called upon to adopt a protective tariff against foreign produce, although they may be expected to meet the reasonable demands of the English agriculturist He cannot fairly describe such import rates as *premia* against home production, and it behoves him to consider, not only whether the rates are justifiable, but whether it would really do him any good, or merely do the railway harm, to minimise such rates On this point *The Times* of the 4th of February 1896 offers some significant remarks, which deserve quotation —

"Sometime ago the Kentish hop growers represented that they were being seriously prejudiced by the importation of foreign hops, and asked if nothing could be done in their interests The company accordingly adopted the extreme course of refusing to carry any foreign hops whatever But the foreigners met this by arranging to send them hops all the way to London by water, and they found, much to their satisfaction, that they could do so cheaper than when they had to pay full railway rates from the coast to London The result was that the foreigner became a stronger competitor in the London market than he had been before The Kentish growers sent no larger supplies than they had done previously, and the South Eastern Railway Company found that they had sacrificed an important item in

their goods traffic without doing good to any body except the very people they had intended to injure "

It is not enough to reduce through rates and local rates to the same level To "boycott' foreign produce altogether is equally useless, since it will certainly find another, and possibly a cheaper route by sea The fact is that the English farmer persists in bringing his "pig to market"—or whatever it may be—in the most troublesome and irregular fashion He may be radical enough to revolutionise rates, but he is terribly conservative in his methods of business At any green grocer s shop we can see how admirably and yet how simply and cheaply foreign fruit and vegetables are packed The difference lies, as Mr Acworth* points out, between the English farmer's basket of eggs and the American car loads

English growers surely have every advantage on their side in the supply of fruit, for the foreign producer has at least to face two rail way journeys, a sea voyage, and the corresponding transhipments Yet this is what Mr Williams† has to say —

' *In the fruit* business proper packing is a *prime essential*, *and in* this matter our people are, of course, far behind the foreigner Mr George Munro, of Covent Garden, stated, at the Crystal Palace Fruit Show in 1894, that English fruit growers were getting worse instead of better He also said—it sounds incredible, but Mr Munro is an authority—that, 'although we have continually improved where there is no competition, we have degenerated to a great extent where there is, and have so far played into the foreigners' hands, who study the requirements of the trade, and try in every possible way to meet them'

Again, while the Hampshire farmer—as *Transport* ‡ observes—consigns one or two hundredweights of meat, all hanging on hooks and demanding constant and special care, there may be in the very same train tons of French, Danish, or Canadian meat, each piece wrapped n its own canvas covering, and so well able to take care of itself Then there are the English farmers' unwieldy masses of forage, taking twice the room of more neatly compressed foreign hay The farmers must learn to pack their produce properly, organize their business, form local centres, and combine in making up large consign ments In short, "the interest of farmers will ultimately be best served by the concentration of produce and by its carriage in large quantities to the market salesman "§

In the meanwhile farmers are being assisted by reduced rates even for small quantities of produce Thus, we find that the Great Western Railway will, at owner s risk, carry (not to a private individual, of course, but) to a market, a salesman, or a dealer, butter, cheese, cream, fish, eggs, game, poultry, fruit, vegetables, meat, etc , in a 10 lbs con

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† Williams

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signment, 100 miles for 6d, 200 miles for 8d, and above 200 miles for 9d If the consignment weighs more than 24 lbs the charge is only ½d per lb for 30 miles, ¼d for 50, ⅜d for 100, ½d for 200, and ⅝d for more than 200 miles

The Great Eastern Railway* was early in the field with a reduced charge of only 4d for every 20 lbs of farm produce and of 1d for every additional 5 lbs up to 60 lbs, including delivery within the usual limits These favourable rates were immediately compared with other existing rates but it had to be remembered that the new rates would only apply where certain conditions were complied with —(1) The produce had to be packed in boxes on sale at different stations, or similar ones (2) The boxes were to be secured by nails, and not by rope or cord (3) The produce would be conveyed at owners risk and carriage prepaid (4) The box should not weigh more than 60 lbs The conditions, in fact, were such as were already complied with by foreign producers, and such as made it possible for the railway companies to quote lower rates

The farmer s difficulty in obtaining payment for the boxes in which he sent his produce was pointed out, and it was suggested that it could be overcome by the introduction of the "Value Payable Post" system, which is such a boon to India

About the same time † the London and South Western Railway introduced reduced rates from non competitive stations for fruit and general railway classifica wards, the rates including boundaries The reductions generally amounted to as much as 20 to 30 per cent Some excellent instructions were also issued by the goods manager He pointed out that if the farmers were clearly told at what low rates large consignments would be conveyed, and if the senders would combine to concentrate their consignments, they would considerably reduce the cost of transit and be able to place a far larger quantity of their produce on the London market

As an example, Mr Henry Rew (one of the Assistant Commissioners on Agriculture) reported that a carrier was able to collect poultry from the different breeders in and around Heathfield in Sussex, to concentrate the produce, to consign it to London, pay the ordinary railway rates, deliver it in the market, and charge the poultry farmer only 1d per bird In the face of this how can it be said that English poultry is kept out of the market by the railway rates?

The London and North Western had, so long ago as 1893, in their general revision of rates largely reduced their charges for the carriage of home grown produce In milk rates the reduction was in many cases as much as one third The company's canvassers, in the course of their careful and wide enquiries, interviewed as many as a thousand farmers, and the following is a summary of their report ‡ —

* *The Times*, November 14 1895 † *The Times*, December 24, 1895.
‡ *The Times* February 15 1896

"(*a*) Number in favour of combination exceedingly few, and no apparent desire to alter present system of dealing with their produce

"(*b*) More than one half of those seen showed absolute indifference in the matter, except that some have taken the opportunity to ask for lower rates with present conditions

"(*c*) To a large extent the traffic is already provided for by low rates, as to which no complaint was made

taken by road

who visit the districts, and pay the railway charges

"(*f*) Generally, there does not appear to be any really acute depression in the farming industry in the London and North Western districts, and most of the farmers did not seem to look upon reduced railway rates as a cure for any depression there might be"

In spite of rates alleged to be almost prohibitive there appeared to be a large and increasing home fresh meat traffic from Scotland, Cumberland, Westmoreland, and other parts to the Metropolis

As an instance of what intelligent combination and organised effort may effect, we may note that within a dozen years Denmark has increased her annual export of eggs to Great Britain from 60 to 200 millions, mainly through the agency of a Co operative Association consisting of 14,000 members, each one of whom is a producer It includes 200 branches which undertake the work of collecting, grading, stamping, packing and shipping

Whether the fault lies with the railway rates, with the farmer, or with the lack of light railways, the English markets are more and more, year by year, flooded with foreign produce A Royal Commission on Agriculture was appointed by Mr Gladstone in 1893 The increase of foreign competition during the last twenty years, the consequent fall in prices and the cost of production, are dealt with in the Report, which was not issued until August 1897 The *Agricultural Returns for Great Britain, etc*, for 1895, also afford ample information for gauging the depth of our agricultural depression

In twenty years (1875 1895) the loss of arable area has been 2,137,000 acres The reduction in wheat growing—from 3,343,000 to 1,418,000 acres—is mainly responsible for this In twenty five years (1866–70 to 1891–95) the price of wheat has declined from *54s 8d to 27s 11d per quarter* *Most of our wheat comes from* the United States (which cultivates 34,880,000 acres), Russia (32,860,000 acres), India (26,030,000 acres), and Argentina, wheat flour is exported to us from the United States mainly, but Canada, Austria, and France also send us a good deal The yields of wheat crop per acre vary considerably—13 bushels in America, 11 in Russia, 9 in India, 19½ in France, and 26½ in the United Kingdom The

following figures will show how enormous our grain imports of all kinds are, and which countries supply most of it —

QUANTITIES of Wheat, Wheat Flour, Barley, Oats, and Maize imported into the United Kingdom from certain Countries in 1894

	Countries from which Exported	Wheat Grain	Wheat Flour	Barley	Oats	Maize.
		cwts	cwts	cwts	cwts	cwts
	Total	70,126 232	19 134 605	31,241,384	14 979 214	35,365,043
Foreign Countries	Argentina	13 272 152	8 435			
	Austrian Territories		1,106 971			
	Chili	1 764 612	1 600			
	Roumania			3 020,182		14 167,972
	Russia Northern,	52 247	9 186	262 567	11,541,807	
	Russia Southern,	16,723,604	24 215	19 184,553	915 099	8,648 416
	Turkey			2 972,697		954,311
	U S of America, Atlantic	15 773,828	15,378 304	7 605		9,534 487
	U S of America, Pacific,	8,884 417	547,182	1,507 146		36,575
British Possessions	Australia	3 651 275	52,972			
	Canada	2 828 515	1,195 421			779,495
	India, Bengal,	280,012				
	,, Bombay,	5 069 044	10 579			

The rye imports, mainly from Russia, amounted to 1,009,226 cwts Of 134,893 cwts of buckwheat, France sent us more than half, and Russia about a quarter Beans reach us from Egypt, Morocco, and Turkey, and peas from Canada, Russia, the United States, and India

Live cattle and live sheep are exported to us from the United States, Canada, and Argentina Of imported cattle the number received in the Metropolitan and Foreign Cattle Markets in 1895 was about the same as in 1875, of imported sheep the number was less [illegible]

been a rapid increase of population, and the increased demand for meat has been met by the development of the frozen carcase trade,

started in 1882 We imported 10,610,394 cwts of dead meat in 1894, of which the United States sent us 6,136,597 cwts, New Zealand 1,003,318 cwts, and Australia 977,788 cwts, Denmark, Argentina, Holland, and Canada also contributing Fresh beef imports amounted to 2,104,104 cwts, of which the United States supplied 1,775,538 cwts, and Australia 301,896 cwts Fresh mutton imports amounted to 2,295,066 cwts, New Zealand sending us 971,072 cwts, Argentina 585,729 cwts, and Australia 468,430 cwts Bacon and hams form a large proportion of the dead meat imported from the United States which sent us 2,561,203 cwts out of 3,689,604 cwts. in 1894, while Denmark and Canada sent much smaller quantities.

While the price of imported butter has been generally maintained during the last ten years, being about £5 per cwt, the quantity has increased between 1890 and 1895 by about 40 per cent, and more than 40 per cent of it comes from Denmark. In 1895 we received 2,825,682 cwts of butter from abroad, and 1,109 325 cwts. of margarine, nearly all from Holland

The value of our imports of rabbits, poultry, game, eggs, and lard has increased from £1 522 673 in 1875 to £7,866,132 in 1895 The [illegible] ,236 [illegible] ussia [illegible] also

We imported [illegible] bushels of raw fruit in 1894 Spain sends us oranges, Belgium apples and pears, France, apples, pears, plums, and cherries, the United States, apples, Italy, lemons and oranges, Holland, apples, pears, and plums, and Canada, apples The value of raw vegetables imported in 1891–94 averaged £2,801,686 Of 2,703,803 cwts of potatoes imported, the Channel Islands (and this is not so unsatisfactory) sent us 1,139,542 cwts, France being also a large contributor The extended cultivation of small fruit in Kent, Middlesex, and Worcestershire is encouraging, however, with the increased acreage of market gardens in Great Britain, from 38,957 in 1875 to 59,473 in 1885, and 92,837 in 1895 In nursery grounds there has been a slight increase, from 12,042 acres in 1875 to 13,290 in 1895 Orchards in 1895 covered 218,428 acres, as compared with 154,584 acres in 1875

Report of Royal Commission on Agriculture—It is reported by the Royal Commission on Agriculture that, as regards meat, foreign competition has been more severe, probably, in pork—*i e*, bacon and hams, mainly—than in other classes, but that no actual displacement [illegible]

consumption in this country comes from abroad

The price of wheat has fallen 50 per cent, that of beef, 24 to 30 per cent, mutton, 20 to 30 per cent, wool, 50 per cent, and dairy produce, milk, cheese, and butter, 30 per cent

Of the three classes of the community most intimately connected with agriculture—landlords, tenants and labourers—the last do not appear to suffer at all, in fact, with wages undiminished and cheaper bread stuffs, the position of the farm labourer was never better than at the present moment Landowners, however, have had to submit to heavy reductions of rental, in some cases they can get no rent at all and the farms are thrown on their hands, not infrequently they have to pay the tithe without any adjustment of rental, and they have had to bear increased expenditure on repairs, drainage, and buildings It is estimated that the value of agricultural land has fallen by as much as £1,000,000 000 Land has been largely withdrawn from the plough, sometimes it has been degraded to the condition of rough pasturage in other cases it has been allowed to become wholly derelict The depression is, of course, most evident in the arable counties, but, on the other hand, there is actually considerable competition for farms in the south west of Scotland and in Wales

Yeomen proprietors have suffered very severely Tenant farmers have perhaps suffered somewhat less than the landowners Stock breeders and graziers have been doing better lately Dairy farmers fruit-growers, and market gardeners appear to have done better than the rest For the majority of farmers, however, there seems to be little hope of relief, to enable them to fight against falling prices, from above or from below, for their wage bills are bigger than ever, and their rents have reached the minimum

Among the recommendations formulated by the Commission are—increased security of tenure to farmers, and full compensation to them for improvements the adjustment—by agreement, not by the action of land courts—of rents to the farmers' returns the relief of farmers

protection against
the encouragement
technical agricul-
istration of dealers
advance of public
their estates for

profitable occupation by tenants, etc Mr Channing differs from the other members of the Commission in considering an alteration of the land tenure laws the first step to be taken towards recovery, while ten of the Commissioners regard bimetallism as the most potent remedy Further reductions of railway rates would in the opinion of the Commissioners, do much to help the farmer That the railways are willing to afford relief in that direction so far as possible we have already seen, but, in order to avail himself of it, the farmer must follow the example of the foreigner and the colonial, and enforce—not sink—his strong Anglo Saxon individuality in intelligent combination

But especially it must be borne in mind that, while Mr Grierson was able, some years ago, to point out that in England branch lines of railway had been carried into sparsely populated districts to an extent unknown in France, Belgium, or Holland, the position in

this respect is practically reversed to-day We were better off than our neighbours* when we had better railway communication than they But now an increasing stream of wine, maize, oil, eggs, poultry, chestnuts, etc., flows from Italy through the St Gothard tunnel and France to England, so that the Lombard peasant can actually undersell the British farmer in the London market That the foreign producer has found in light railways most powerful allies, cannot be denied "To compete with foreign producers," was the avowed object of the Belgian light railways But the development of minor railway communications in Great Britain has been arrested by obstructions which no small project could successfully overcome It has been necessary *for every railway to face most costly investigations* before Private Bill Committees of first one and then the other House of Parliament, and to satisfy the demands of opposing interests, before an Act could be obtained authorising the construction and working of the line Then the regulations of the Board of Trade were applied as rigorously to a small and poor line as to a great system with an enormous traffic so that—as the Hon Secretary and Manager of the Easingwold Railway observed†—far from encouraging small lines in the interest of agriculture, "Parliament and the Board of Trade block the way instead of clearing it" In the matter of rates, no better terms were conceded to the branch than to the long lead main line Thus it is that, unless he owns a cart, the villager must either depend upon his own legs, or await the coming of the carrier, to take him to the nearest market-town, and the want of an efficient means of carriage has thrown the British producer more and more into the background The repressive effect of this isolation upon the energies of the agricultural population need not be dwelt upon It would almost seem that they could place no confidence in any scheme for their relief, and it was rather through the continued efforts of those who had studied the advantages secured in other countries by the development of cheap lines, than in response to any determined demand from the British agriculturist, that the Light Railways Act of 1896 was passed The relief afforded by this measure may be briefly summarised It is not now necessary to obtain a special Act for the construction of a light railway Enquiries are held locally by the Light Railway Commissioners, and also by the Board of Trade, if the latter think fit Light railways may be more leniently treated in details of permanent way, gauge, fencing, the crossing of public roads on the level (instead of by means of overbridges or underbridges), block signals, brake power, station requirements, etc The track may be laid on a public road, if required Local authorities—the council of any county, borough,

* *The Times* March 7, 1894

† *Journal of the Society of Arts*, Feb 15, 1895, Acworth on "Light Railways"

or as part of the share capital Land may be compulsorily acquired under the Arbitration Act of 1889 without recourse to Parliament, and "betterment" will be duly considered in fixing compensation The Treasury may afford assistance under certain conditions

[illegible] al stage Its
way develop
en, perhaps,
most striking and most successful in Belgium, to which the following chapter will be devoted

CHAPTER III

LIGHT RAILWAYS IN BELGIUM

CONTENTS —Early railway enterprise—Belgian railways the medium for international traffic—Light railways required for internal traffic—Formation of the "Société Nationale de Chemins de Fer Vicinaux" in 1885—Provision of capital—Division of profits—Constitution of the Society—Procedure for obtaining concess . . .

. . . Financial results of . . . Society's views on . . . railways—Belgian . . . Belgian railways— . . . association of Government monopoly and private enterprise

Railway Systems.—Belgium—which presents to us to-day the most complete system of high . . . Continental nations to follow . . . of railway construction, for . . . particular facilities North and west, the surface lies low and very level, but it is intersected with canals and rivers requiring a good deal of bridging, while to the south and south east—rich in quarries of stone and mines of coal, iron, and zinc—the ground is exceptionally rugged and broken, and the engineering work was heavy As a matter of fact, the railways of Belgium have cost about as much (£26,611 a mile) as those of France (£27,375 a mile) Yet, at the end of 1894 the mileage of railways open in Belgium, the United Kingdom, France, and Germany respectively was 29 1, 16 6, 11 5, and 13 6 per 100 square miles, and 5 4, 5 3, 6 4, and 5 5 per 10,000 inhabitants But, although the natural difficulties were such as demanded comparatively high expe . . . intermediate position between two . . . energetic policy, which soon covere . . . stimulated by jealousy of Holland, which had hitherto secured, through the Rhine, most of the traffic between Germany and England Railway communication was established between the ports of Ostend and Antwerp on the north and the frontiers of France and

Prussia on the south and east The main lines were planned and executed by the Belgian Government and, where the State did not care to take matters into its own hands, private companies were allowed to complete the branches and connections The mineral and manufacturing wealth of the country grew apace, and Belgium, instead of the Rhine and Holland, furnished, through her railways, the most direct trade route between Central Europe and England

Not only did the State originate and construct the main lines, but it has continued to work them, and even those which had been conceded to private companies have nearly all reverted to State management The whole of the national system is under the direction of the *Minister of Railways*

Thus, in main lines of railway—as well as in roads and navigable canals and rivers—Belgium was well supplied It still remained to complete minor lines of internal communication by means of light railways, and in 1885, when agriculture and trade were in a state of serious depression, the "Société Nationale de Chemins de Fer Vicinaux" was formed with the object of building "light railways or steam tramways along existing roads and with a narrow gauge, which would admit of cheaper materials in the construction of the lines, and less expensive rolling stock would thereby insure the greatest economy, and, through the consequently reduced rates, would enable agriculturists and others to convey the produce of their labour to local markets, and also to compete with foreign producers" This, of course, very much describes the hopes of those who have pressed for [illegible]

[illegible] ght Railways —The [illegible] ailways" forms the [illegible] the Communes, and, to a very limited extent, private enterprise Dealing with lines of purely local interest, it keeps the capital and accounts of each line separately, but the direction of the whole system is centralised in one administration By Royal Decree, the Society has the absolute monopoly of constructing such lines as local authorities desire, and only in case of the Society not caring to take advantage of its right of preference within a certain period can any other company or individual obtain a similar concession The Society and its lines are, as far as possible, relieved from payment of dues, rates, and taxes

The Society determines, after consideration of a particular project, the capital to be subscribed Of this at least two thirds must be subscribed by the State, the Provinces, or the Communes, but, as a matter of fact, private individuals do not largely avail themselves of the privilege, especially reserved to them of subscribing the remaining third of the capital Although the State is legally empowered to subscribe as much as half the capital, it is usual to limit the Government subscription to one quarter, and the Provincial and Communal Authorities are expected to raise the remaining three quarters, the

intention being that the Communes should be the largest subscribers, as it is in their interests mainly that the light railway movement was projected No limit is prescribed for the contributions of the Provinces and the Communes, but those of private individuals must not exceed one third of the capital of such line After the ninetieth year of working has expired, the State, the Provinces, and the Communes concerned may buy out the private shareholders at par rate

Instead of advancing the whole amount of their contribution at once, the State, the Provinces and (if they can show sufficient security) the Communes may furnish their subscriptions in the form of contingent annuities spread over a period of ninety years, and calculated at $3\frac{1}{2}$ per cent, interest and amount paid off included The Society, moreover, may issue debenture bonds representing the annuities due to it

Of £2,349 760, the amount subscribed up to the end of 1893, the State had advanced £635,840, the Provinces £658 080, the Communes £960,160, and private individuals £95,680 This comes to 27 per cent from the State, 28 from the Provinces, 40 9 from the Communes, and 4 1 from private individuals

After meeting the cost of maintenance and working, the profits of each line go, first of all to paying off the annual subscriptions of the public shareholders and the payment of a first dividend to the holders of paid up shares—i e, to private individuals, the dividends not to

and Director General have received their commissions, any surplus remaining is divided in the proportion of—

(1) One-quarter to form a fund for extending and improving the line

(2) and

(3) fund

to cove light railways

The reserve fund of each line may now be drawn upon for the declaration of dividends, but only with the authorization of the Government

An ex the profits of the Antwerp Turnhou is here quoted from Mr G Cary El Maje ty's *Representatives Abroad*

Net Profits,	£4613
Interest on Capital available,	5
Total amount to be divided,	£4618

First Dividend—	
Annual Subscribers, at $3\frac{1}{2}$ per cent,	£2687
Holders of paid up Shares, at $4\frac{1}{2}$ per cent,	412
Charges* to Administrative Council and Director General,	212
Improvement Fund,	327
Second Dividend—	
Annual Subscribers, at $\frac{1}{2}$ per cent,	438
Holders of paid up Shares at $\frac{1}{2}$ per cent,	52
Reserve Fund,	490
	£4618

In this case the annual subscribers—the State the Provinces and the Communes—had their $3\frac{1}{2}$ per cent subscription for the year paid back to them in the first dividend, and received an additional $\frac{1}{2}$ per cent in the second dividend, while private individuals received their full $4\frac{1}{2}$ per cent in the first dividend and a bonus of $\frac{1}{2}$ per cent in the second dividend

If the working expenses of a line exceed the receipts, the deficit is made good by the National Society from the general reserve fund, subject to recovery from subsequent profits of the line, and, so far, the resources of the Society have never, on this account, been over strained On the other hand if the receipts do not cover the working expenses for three consecutive years or even if for five consecutive years the profits are less than half the interest charges on the first cost capital, the National Society has the power of closing the line to traffic and debiting the loss to the reserve fund As a matter of fact, the net earnings cover more than four fifths of the interest charges at $3\frac{1}{2}$ per cent on the capital expended by the Society on the lines worked

The National Society is under the administration of a Council or Board composed of a President or Chairman, four (or, if Government require, six) members or directors and a Director General or Managing Director The Council has considerable powers

According
annually from
sions at 2 per
of the first
receives a fixed salary, *plus* commissions at the rate of 4 per cent (but subject also to a maximum of £400) It is his duty to see that *the decisions of the Council are carried out, and to direct generally* the business of the Society

Then there is the "Comité de Surveillance," or Supervisional Committee, of six members, annually nominated, who draw salaries fixed (according to their attendance at meetings) by the General Assembly It is their business to check the audit of accounts and stock taking,

* Calculated on the net profits exclusive of the interest on capital available.

to inspect all the lines in turn, and generally to look into the affairs of the Society.

Finally, the General Assembly is composed of shareholders, members of the Council and of the Supervisional Committee, and the Director General. Each Province and Commune is represented by a delegate. Each share carries a vote, but no one may vote in respect of more than one-fifth of the total number of shares issued, or two-fifths of the shares represented at the Assembly. The meetings are annual, but extraordinary meetings may be summoned by the Council, if demanded by the Supervisional Committee or by shareholders representing one-fifth of the capital of the Society.

A month later in the same year, 1885, another Royal Decree was issued, prescribing the procedure for obtaining a concession to construct a local railway.

Formal application is made by the National Society to the Department of Agriculture, Industry, and Public Works. With the application are to be submitted—a report, a detailed estimate, the proposed rates and an estimate of the probable receipts, a specification of the project, a copy of the Government map (scale $\frac{1}{20000}$) of that part of the country through which the line is to run, a general plan (scale $\frac{1}{2500}$) showing the line and sidings, a special plan (to a scale of $\frac{1}{500}$) of ground occupied by houses, a longitudinal section and, so far as they are required, cross sections, and detailed drawings of particular works and the type of permanent way adopted.

After preliminary examination (and, if necessary, an enquiry) by the Department, the papers are made available for inspection by the public in the town hall of each Commune for fifteen days, in order that objections and criticisms may be recorded. These, with the opinions of the Communal Councils interested, are passed on to the Provincial Councils, and by them, with remarks, are once more submitted to the Department for final consideration and, if necessary, further enquiry. The Department may make such mo[illegible]

[illegible] signature of the K[illegible] [illegible] its the

The compulsory acquisition of land may be provided for, if necessary.

The aim of the Society has been, of course, to construct their lines as cheaply as possible, and to lay them, where practicable, on existing roads. The cost has been, as a rule, less than £3000 [illegible] per- [illegible] gard to [illegible] n laid [illegible] 1·067 [illegible] Dutch vicinal lines; and 40 miles to standard gauge (4' 8½"), where it was desirable to avoid transhipment of goods to or from the main lines. Practically, it is a metre-gauge system.

The intention is, so far as possible, to lay the way on the sides of

existing roads In that case, the permanent way* costs as much as £977 per mile, as against £793 on independent formation, laid in
course, rising in price from £1108
the pattern adopted On roads, a
s on iron bearing plates, through
sleepers
s as our
usually
There
joint or
guard sleepers being 1 9, the next interval 2 10½, and the rest 3 1¾ It will be noticed that the guard sleepers on either side of the joint are set much closer together than is usual with us The fish plates have an angle section, and are 17 long This is the general type of metre gauge permanent way The limiting radius of curves, outside towns, is 246 feet The railway is marked off from the rest of the road by a raised border or row of kerbstones, a somewhat expensive item, the line of these is broken at intervals to afford outlets for open cross drains Curves being often very sharp, especially in towns and factories the National Society has made a special study of them, and laid down particular rules in regard to the super elevation or cant, and the setting out of parabolic curves It is obviously better in the case of road railways to obtain the requisite cant by lowering the inner, as well as by raising the outer, rail, so that the centre line of the track may keep the road grade The usual formula—

$$E = \frac{G V^2}{g R}$$

has been adopted by the Society, where G = gauge, V = maximum velocity, g = accelerative force of gravity per second, and R = radius of curve The maximum speed is 18 6 miles per hour in the country, and 6 2 miles per hour in towns The latter speed requires a very small cant indeed, even with sharp curves Slack gauge varies from ⅛ of an inch for curves of 150 feet radius to ⅜ of an inch for 100 feet curves, the allowance being fixed for the type of locomotive used With a 47 3lb rail
length of 29 6½'
Z sectioned metal sl
shoe bolted to them,
one lug of the chair, and keyed up under the other As we find in

* *The Engineer*, April 10, 1896

maintain the pavement between the rails, and a strip twenty four inches wide on each side The roadway is not only paved in towns,

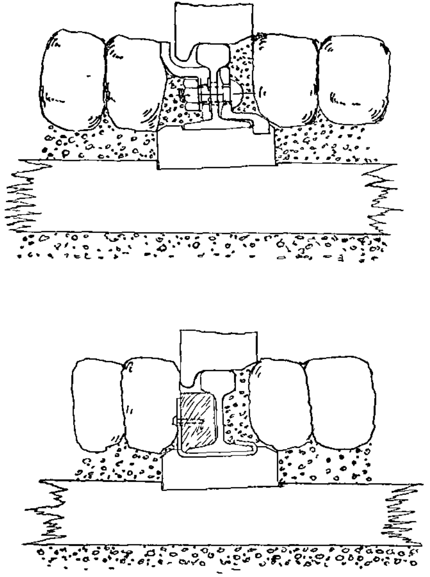

FIG 1 —Permanent way, Belgian Light Railways
Mode of fixing rails in streets of towns.

but also in such exceptional places as level crossings, entrances to private works, etc, in the country. For fuller particulars of the per

manent way as well as of the rolling stock, the reader is referred to *The Engineer* for April 10th, and May 1st, 1896, and to *The Railway World*, June 1896

For general service locomotives weighing 15¼ tons in full working order, and for heavy goods trains those of the type weighing 27 tons, are commended by the writer in *The Engineer* who made several journeys with both classes of engine The wheels are ordinarily six coupled, with a diameter of 2 8¾ and a base of 5 10⅝ The cylinders and frames are outside the wheels, to steady the engine as much as possible *Coke is burned only in the towns, in the country coal* dust briquettes are used as fuel, but the smoke from them is objectionable

The bodies of the passenger carriages are built of teak, lined with pitch pine inside, and covered with $\frac{3}{64}$ inch sheet-iron outside, the under frames are iron, the flanges of the wheels are of steel, the naves and spokes of forged iron, and the axles are of steel The *seats of the second class carriages are arranged transversely, with* a

compartment of which is first-class and the other second class The doors are at the ends of the cars, and open on to a platform, such as our carriages in India are frequently provided with The total length of frame is 22 3¾ , the width over all of the body of the car 7 11 and the central height of the car 9 6 above rail level The diameter of wheels is 1 11⅝″, and there are four wheels to a car, with a wheel base of 7 10¼ A first class or a composite carriage weighs 4 tons 10 cwt , a second class carriage 4 tons 8 cwt , and a luggage van (which is built as nearly as possible on the same lines) 5 tons The cost of a first class or of a composite is £152, of a second class £130, and of a luggage van, £120

The rolling stock is supplied to the working companies or lessees by

ervice, most of them weighing 18 *were some weighing* 22, 24, 27¼, and 30 tons

Of 716 passenger vehicles in use—10 closed and 10 open were for horse traction, 116 were first class, 399 second class, 128 mixed first- and second-class, and 21 mixed carriages with luggage and goods compartments, *they included also 32 bogies, of which 10 were second* class, 8 mixed first- and second class, and 14 mixed first class, second class, and goods compartments

There were 140 luggage vans, 76 covered goods wagons (5 tons), ... wagons (10 tons) ... 108 ... ... wagons (5 tons) agons (5 tons), 151 flat ..., and 3 cisterns

francs per kilometre or ...ly 1 engine per 3 miles,

1 passenger carriage per 1 mile, 1 luggage van per $5\frac{1}{2}$ miles, and 1 goods wagon per $\frac{1}{2}$ mile of main line

It is not the practice of the Society to work the lines itself, but to lease them out to working companies, and so to afford a field for private enterprise The lessees may be individuals, companies, or—in some instances—associations formed by the local authorities As in France, has been to establish satisfactory r traffic In both countries the . which gave the working agency a certain proportion of the gross receipts, and, so long as the agency could secure its remuneration from goods bearing comparatively high rates, it had no further interest in the development of larger and more important traffic, which could only bear very low rates

Moreover, the Belgian National Society, like the French Departments, found it advisable to reap the full benefit of its own credit by providing the whole of the capita of the lines It even equips them the payment of interest on outsid demanded an altogether inadequate security of *2000* francs per kilometre, or £129 per mile from the lessees, which left it at the mercy of the latter, if they chose to sacrifice that amount and throw up the contract rather than face heavy and sudden expenditure on renewals of way and stock Considerable modifications have accordingly been made in the terms of lease, and those now in force are described by M de Burlet (General Manager of the Society) in the *Bulletin de la Commission Internationale du Congrès des Chemins de Fer*, vol ix, 1895, from which is derived the following information —

So far as possible, connected lines are grouped under one working company The lines are worked on a thirty years' agreement, terminable, however, at the end of fifteen years on twelve months' notice by either side, but the liability to closure at the end of a shorter period tends so much to limit the interest of the lessee in the line that this clause is usually omitted

The National Society leases the line and all appurtenances thereof tock and, nd to be inadequate, and it has, accordingly, been increased by the institution of a renewal fund to which the lessee must contribute £19½ per mile, and by a charge of £160 per locomotive, of £16 per passenger

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alterations

Monthly returns are submitted to the Society for audit of the receipts under each class, and separate division sheets of earnings,

showing the proportions due to the working company and to the National Society

The minimum number of trains is generally as many as five in each direction, and the Society may call for an increase in the number of trains when the gross receipts per mensem average more than 1s 11d per train mile

The rates are scheduled in the Act, but the National Society may alter them with the sanction of the Government

To make up for possible lack of enterprise on the part of the working company, the National Society has organised a special traffic staff to study the peculiar requirements of the trade, manufactures, and industries of the country, to consider complaints and claims, to conciliate the interests of both lessees and the public in the matter of rates, and to attract and foster traffic in every way.

The location of stations, stopping places, private junctions, etc, is fixed by the National Society

The Belgian formulæ of division are the following —

$$\left.\begin{array}{l} F = 1500f + p\,R \\ L = £97 \quad + p\,R \end{array}\right\} \qquad (1)$$

where F = working subsidy, in francs per kilometre, R = gross receipts in francs per kilometre, and p averages 0 30 L and R, in the second equation, expressing the working subsidy and gross receipts in pounds sterling per mile This formula has been abandoned

$$\left.\begin{array}{l} F = p\,R \\ L = p\,R \end{array}\right\} \qquad (2)$$

where p averages about 0 60, and the working subsidy is subject to a minimum of 2000 francs per kilometre or £129 per mile This is considered by M de Burlet to be the best formula for the more prosperous lines.

$$\left.\begin{array}{l} F = 1900f + p\,(R - 1900f) \\ L = £122 \quad + p\,(R - £122) \end{array}\right\} \qquad (3)$$

where p averages about 0 25. This formula is only applied to a few lines

$$\left.\begin{array}{l} F \\ L \end{array}\right\} = C + 0\,50\ (R - C) \qquad (4)$$

where C may be 1000 1300 or 1500 francs per kilometre and [illegible]

It gives the lessee better terms, when the receipts are low, than formula 2

In order to show roughly the comparative effect of the application

of these formulæ, it will be sufficient, perhaps, to quote only three lines of M de Burlet's table, and to give the English equivalents

Gross Receipts	(1) 1500 + 0 30R		(2) 0 60R		(3) 1900 + 0 30 (R 1900)		(4) 1300 + 0 50 (R – 1300)	
	Owner	Lessee	Owner	Lessee	Owner	Lessee	Owner	Lessee
Francs per kilometre	f	f	f	f	f	f	f	f
1500	450	1950	600	900		1500	100	1400
3750	1125	2625	1500	2250	1295	2455	1225	2525
6000	2700	3300	2400	3600	2870	3130	2350	3650
Pounds per mile	£	£	£	£	£	£	£	£
97	29	126	39	58		97	6	91
241	72	169	97	144	83	158	79	162
386	174	212	154	232	185	201	151	235

M de Burlet draws attention to the special case where running powers are given (an intermediate third rail being laid to smaller gauge) by the State Railways to the Coastal Light Railway over a

for providing engines, train staff, booking clerks, etc, receives six francs per train kilometre, or 7s 8 69d per mile The light railway connects certain watering places between Ostend and Nieuport, and

The following information, regarding rates and fares, is quoted from Mr Gervase Cary Elwes' report* —

"The charges for the carriage of goods come under two heads (1) carriage by fast trains, and (2) carriage by slow trains The

oading, registration, etc

* *Commercial No 9 (1894) Reports from Her Majesty's Representatives Abroad on Light Railways*, pp 13 15

"The tariffs for slow trains are divided into —

"Class I (for Goods weighing less than 5 tons)

1	A fixed rate for all distances	5d per ton
2	Loading and unloading	10d "
3	A variable rate per ½ mile	1¾d "

A charge of 3d is made per consignment for registration, etc

"Class II (for Good weighing 5 tons or over)
Tariffs (A) and (B)

1	A fixed rate for all distances	5d per ton
2	A variable rate per ½ mile—	
	Tariff (A), in covered trucks	1¼d "
	Tariff (B), in open trucks	1¾d "

"Tariff (C) (for bulky Goods)

1	A fixed rate for all distances	5d "
2	A variable rate per ½ mile	1d "

"Goods in Class II, Tariff (C) are sent in open trucks, without the Society being held responsible

"In Class II, Tariffs (A) (B) and (C), a charge of 3d is made per consignment for registration etc, as in Class I

"In 1886, with the intention of aiding agriculture, the National Society established a special tariff for —

"(*a*) Lime, lime ash mud from towns, limestone residue from sugar factories to be used as manure

"(*b*) Residue from distilleries, to be used as provision for cattle

"(*c*) Cinders, slag, rubble from coal pits, and quarry waste, to be used for improving roads, to be charged as follows —

' 1 A fixed rate, for all distances, per ton, 5d

' 2 A variable rate per half mile, per ton, ½d

"And a special tariff for—

"(*a*) Chemical and artificial manure

"(*b*) Agricultural produce used as domestic provisions, to be charged according to Class I, with a minimum charge for 4 cwt, instead of 8 cwt

"In 1888 a reduction was made in the rate charged for the transport of live animals, which resulted, in the following year, in a noticeable increase in that particular traffic, while in 1889 further reductions came into force for the transport of freestone, coal, beet root pulp, and phosphates, and special rates were established for various products, such as wood for building, bark, cereals, potatoes

has seen the estab

r the transport of

tow, hemp, malt,

tobacco, raw sugar, manure, raw salt, petroleum and vinegar in casks, nitrates, fresh vegetables, fruit, meat, sulphuric acid and night soil (in special wagons) In many of these cases the variable rate per half mile has been reduced from 1½d and 1¼d to 1d, from 1d to ¼d, and from ½d to ¼d, while empty tins, casks boxes, and baskets are now transported free of all charge

"All the light railways are used for passenger traffic, as well as for the carriage of merchandise, and there is one line which is reserved entirely for passengers There are first- and second class carriages only, the general price of tickets being at the rate of ¾d per half mile, first-class, with a minimum of 2d, and a ½d per half mile, second-class, with a minimum of 1½d On a few lines slightly higher rates are insisted on by the Government, to prevent competition with the ordinary railways Luggage is carried at the rate of ¾d per 2 cwt per half mile, with a minimum distance of 3 miles charged 50 per cent reduction, with a minimum distance of 9 miles, is allowed to members of schools and societies when travelling together, in which class are also included, for instance, members of circus companies There are also season tickets for schoolboys, available for at least three months at a reduction of 50 per cent on twice the price of a single ticket, and since 1890 season tickets, allowing four journeys daily, have also been in use for schoolboys enabling them to return home in the middle of the day, as well as after school hours in the evening

"Weekly tickets for workmen are in use, varying, as to the rate of reduction in price, from 50 per cent for distances from half-a mile to 3 miles, to 60 per cent for 5 miles, the reduction being on twice the [illegible]

tickets and this new tariff met with great success the following year In 1891 the National Society issued workmen's weekly tickets available for a single journey each day, as in some cases the hours of the trains suited workmen going to their work but not returning therefrom, or *vice versâ* and this was a popular and subsequently successful innovation

"Policemen have free passes on the light railways except when they are conducting a prisoner Soldiers are allowed 50 per cent reduction Dogs have to be paid for at the same rate as second class passengers

"Ordinary return tickets are issued on most of the light railways at a reduction of 20 per cent, while in at least one instance 50 per cent is allowed on market days, and on one line the agriculturist may take his produce in market trains free of charge A twofold benefit results from these reductions, carried on as they are gradually, [illegible] ever [illegible] ls for market at very low fares, and this has increased such traffic

siderably A very good idea of the out door working of Belgian light railways may be obtained from the report* of Major Addison, R E He inspected the line from Andense to Eghezee, which is 12½

Vignoles or flat-footed section, weigh 42 lbs per yard, and are held down by dog spikes to creosoted sleepers, measuring about 4 8" long, 8" wide and 4" deep At road crossings, and in passing through villages, the tramway type of way is adopted Points are worked by a lever in the country and in towns by a key fitting a screw head placed between the rails One train in the day each way takes only 1 h 5 m to do the 12½ miles, the other trains make the journey in 1 h 25 m The engine is six-coupled, weighs 18 tons, and its wheels have a diameter of 3 feet It may be driven from either side (the driver standing on whichever platform is in front), it is provided with hand screw brakes, and all moving parts are cased The engine is manned by a driver and a stoker Where a loop is required, the running line is outside, in order that the carts may have access to the straight siding The light line connects at Eghezée with the State Railway, but there is no actual junction of gauges Persons riding or driving horses are warned, on the approach of trains, to keep at least 5 ft clear of the rails, and, if they are not sure of the behaviour of their horses, they are to dismount and lead them until the train has passed. Level crossings, except in very few instances, are neither watched nor guarded in any way

Most trains are mixed, the goods wagons being, as a measure of safety, placed between the engine and passenger carriages This arrangement makes it impossible to warm the latter from the engine, so the pipes are heated from a small boiler placed on the front buffer beam of the carriages

On some lines screw brakes, on others continuous brakes are used, in the latter case, engine, wagons and coaches are all fitted with them †

For the financial results we shall first return to Mr Gervase Cary Elwes' Report, above referred to His figures bring us to the end of the year 1893

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* *The Electrical Engineer*, January 4 1895

† [illegible] on Brakes " *Bull de la Comm Internat du Cong des Ch. de Fer* vol viii, 1894

private individuals 3 88 per cent Moreover, the average percent age of dividend has gradually increased, thus —

In 1890	it was	2 65
, 1891	,,	2 75
1892	,,	2 76
,, 1893		2 80

The cost and capital of sixty one of these lines, covering a total length of 726½ miles, may here be given as an example of the distribution of expenditure —

INITIAL EXPENSES—	Total	Per Mile
1 General Expenses and Sundries,	£194,962	£268
2 Purchase of Land,	158,620	218
3 Labour and Material	982,064	1352
4 Buildings,	207,823	286
5 Rolling Stock,	421,760	580
	£1,965,230	£2,706
Capital Subscribed,	£2,154,080	£2,967

Comparison of Belgian and Indian Light Railways —We may, therefore, take £2700 per mile as roughly the cost of metre gauge light lines in Belgium, and compare it with the cost of Indian lines on the same gauge The Rajputana Malwa Railway (see Table in Appendix IV) cost Rx 7604, or (taking Rx = £0 6, for purpose of *comparison) £4562* per mile, *but then it occupies the position of a* main line, it has to work up to the collar to cope with the heavy [illegible] as well laid [illegible] it must not [illegible] e the figures furnished by the Company's section of the Rohilkund Kumaon Rail way, Rx 3841, or £2304, by the Jodhpore Railway, Rx 2004, or £1202 per mile, and by the Bickaneer Railway, Rx 2229, or £1337 per mile And, to make the comparison as useful as possible, let us take the cost in detail and re group the headings, as nearly as may be, in accordance with those of the Belgian expenditure, as shown on the next page

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On some lines screw brakes, on others continuous brakes are used, in the latter case, engine, wagons and coaches are all fitted with them †

For the financial results we shall first return to Mr Gervase Cary Elwes' Report, above referred to His figures bring us to the end of the year 1893

Taking those railways only which had been working for at least one year (and compressing his figures), we find that the State subscribed £493,440, the Provinces £501,520, the Communes £730,920, and

ividend

varied

3, and

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next page

	Corresponding No of Head (Belgian)	Rajputana Malwa		Rohil Kund Ku maon (Company s) Section		Jodhpore		Bickaneer	
		Rx	£	Rx	£	Rx	£	Rx	£
Preliminary charges General charges	(1)	634	380	504	302	41	25	42	25
Land	(2)	78	47	4	2				
Formation Bridge work Fencing, etc *Electric Telegraph* Ballast and Permanent Way	(3)	4100	2460	2194	1316	1561	937	1803	1082
Stations and Buildings Plant	(4)	1237	742	407	244	131	78	162	97
Rolling stock	(5)	1262	757	732	439	272	163	222	133
Loss by Exchange		293 *	176 *						
		7604	4562	3841	2304	2004	1202	2229	1337

* It is impossible to distribute this, but it mainly belongs to permanent way and rolling stock

As the conditions in any two cases are never identical, and bare

this head cannot be compared with the others, there must be particular reasons for the phenomenally small amounts, and we shall not be far wrong in concluding that the survey was carried out under the orders of the State engineer, no part of his salary or of office expenses being debited to the railway, but only the pay of the small native staff actually in the field.

The native states of Jodhpore and Bickaneer built their railways on their own land, so there was no charge under this head A considerable portion of the Rajputana Malwa Railway runs through land granted by the native states, and, even in British territory—where, although the procedure of compulsory acquisition is simple, the official valuation is exceedingly liberal—the cost is so small as to make comparison with the cost of European land impossible

The next head, 'labour and material," includes the most expensive items of all "Formation and "bridge-work" cost little in the sandy Bickaneer Desert, not more than £83 per mile on the Jodhpore and £120 per mile on the Bickaneer Railway, but they were unavoidably heavy items on the Rajputana Malwa line, £260 per mile for "formation" and £774 for "bridge-work"

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many years, with 41½ lb steel rails, but the 400 odd miles of main line between Delhi and Ahmedabad are laid with a 50 lb steel rail, which has been adopted as the standard rail for the line The fastenings and ballasting are equal to the rail, so the exceptional cost

Moreover, in the other cases, serviceable light rails were frequently available at cheap rates from main line renewals The permanent way of the Rajputana Malwa is not that of a light, but of a first class line

In regard to the whole question of cost of "labour and material," it must be remembered that unskilled labour is far cheaper, and manufactured (and imported) material is far dearer than in Europe These compensate one another, perhaps, very roughly, in accordance with the great contractor Brassey's dictum that the cost of work, all round, is the same all the world over No doubt labour in India is dearer than it used to be, and the Indian rupee, instead of being

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Malwa is too heavy, [illegible]
the provision of fenci[illegible]
of the bridge work too exceptional, for that line to be classed as a light one On the other hand, the peculiar advantages of the

Jodhpore and Bickaneer lines in regard to direction, supervision, survey expenses, etc, and their meagre requirements in the way of [illegible] e us to quote them as

extent) on "stations and kind of business ... an another on these accounts, it should be because the traffic requires it, and in that case the greater first cost per mile is justified Now the gross earnings per mile of the Rajputana Malwa Railway are Rx 1416, of the Rohilkund Kumaon Rx 696, of the Jodhpore Rx 337, and of the Bickaneer Rx 185, and (although the quantity of traffic is by no means the only important factor) the cost per mile of rolling stock follows the same order

Sufficient reasons have been given for rejecting the high figures of [illegible]

a comparison being drawn with other light lines But the figures of the Rohilkund Kumaon line and of the Belgian Light Railways are so singularly parallel that it is worth while to repeat them here side by side —

	Belgian Light Railways	Rohilkund Kumaon Railway.
	Cost per mile	Cost per mile
1 General Expenses and Sundries,	£268	£302
2 Purchase of Land,	218	2
3 Labour and Material,	1,352	1,316
4 Buildings,	286	244
5 Rolling Stock,	580	439
	£2,706	£2,304

If we eliminate the accidental difference in the purchase of land and the independent difference in the provision of rolling stock, we have [illegible]

[illegible] would be altogether misleading And, as we have seen, it would be equally misleading to make the comparison between the Belgian

figures and either the exceptionally high figures of the Rajputana Malwa Railway or the exceptionally low figures of the Jodhpore and Bickaneer railways. Having considered and rejected these examples, a few remarks may be made about the Rohilkund Kumaon Railway (Company's section)

This line runs from Bhojeepura Junction (12 miles from Bareilly on the main line) to Kathgodam (at the foot of the Himalayas and the terminus for the hill station of Naini Tal), the total length being 53 92 miles It was constructed, under a Government 4 per cent guarantee (with a subsidy of Rx 4000 or £2400 per annum from the North West Provincial Government), by an English company, which also works the Lucknow Bareilly line and it was opened for public traffic at the end of 1884

The rails are laid on sal wood sleepers, which cost little, and the line is unfenced except at stations The gross earnings were Rx 45,931 on (adding the 12 miles between Bhojeepura and Bareilly) 66 miles worked, or Rx 696 (£418) per mile, the expenses Rx 24,304, or Rx 368 (£221) per mile, and the net earnings, therefore, Rx 21,627, or Rx 328 (£197) per mile On 58 Belgian light railways open at the end of 1893, with a length worked of 1156 kilometres or 718 miles the total receipts were 4,684,355f (£187,374), an average of 4052f per kilometre, or £261 per mile, the expenses 3,363,490f (£134,540), an average of 2909f per kilometre, or £187 per mile, and the net receipts, therefore, 1,320,865f (£52,834), an average of 1143f per kilometre, or £74 per mile

The ratio of expenses to receipts is, on the Belgian lines, about 72 per cent, and, on the Indian line about 53 per cent But the differences in the nature of the traffic, in the receipts per mile, in the working of a long and of a short lead traffic, and in the working of

is only 54 miles long, but the same Company works also the Lucknow Bareilly section and the Dadhwa branch, State built lines, which make up the total mileage worked by the Company to 285 miles The average lead of passengers on this system is about 33 miles, and that of goods 65 in the first, to 87 in the second, half of the year The amount of business done, too, is much less on the Belgian than on the Indian lines In regard to the nature of the business, it may be observed that the ratio of passenger to goods receipts is about 75 per cent in the former case, and 42 per cent in the latter, indeed, on most Indian railways, the goods bring in far more earnings than the passengers

All these differences, too, prevent us from making a comparison between the rolling stock of the Indian and Belgian lines On the former, 27 locomotives, 166 passenger vehicles, and 674 goods

vehicles suffice for 285 miles of line worked as one system The
e 253 locomotives, 716 passenger
age vans, and 6 special vehicles
figures, however, illustrates the

Kumaon Railway system as likely to be fairly accurate for the Company's section also, the average passenger fare per mile in 1894 was 2 6 pies, or say, 0 195d (well under $\frac{1}{4}$d), and the average rate per ton of goods was 5 6 pies or 0 42d (less than $\frac{1}{2}$d a mile) The lowest passenger fares per mile on Indian railways vary, in average, between 2 and $2\frac{1}{2}$ pies but the Madras Railway (to its loss, for the reduced fares merely meant reduced profits) were much lower even than that The lowest or second class fare on the Belgian light lines is 5 centimes, and the first class fare not much higher, 7 centimes * Professor Hadley, in his *Railroad Transportation*, observes that the Belgian "passenger rates are lower than anywhere else in the world, except, perhaps, on some East Indian railroads" His cautious qualification is quite unnecessary We must not infer that Belgian lines would gain by lowering their fares to the Indian standard It is merely a case of not charging more than the traffic will bear The Indian wages, both of the fourth class passenger and of the railway menial, are generally no more than 4d a day, so that less working expenses compensate, in this and in other ways, for the smaller fares From an average rate per ton per mile of goods we can learn nothing In 1894 it was 5 03 pies on the East Indian Railway, 6 50 on the Bengal Nagpur, 6 72 on the Indian Midland 9 11 on the Eastern Bengal, 8 36 on the Great Indian Peninsula, 7 68 on the Bombay, Baroda, and Central India, 8 59 on the Madras, 6 26 on the Bengal and North Western, 6 33 on the Rajputana Malwa, and 9 88 pies on the Jodhpore Bickaneer Railway Exclusive of terminals, fifth class goods may pay as much as 1 pie per maund, *i e*, $2\frac{1}{4}$ annas (or about 2d) per ton per mile, while first class goods may pay as little as $\frac{1}{6}$ pie per maund, *i e*, $4\frac{1}{2}$ pies (or about $\frac{1}{3}$d) per ton per mile, and the special class goods minimum rate (as, for example, for coal and coke) is $\frac{1}{10}$ pie per maund, *i e*, 2 7 pies (or about $\frac{1}{5}$d) per ton per mile The East Indian Railway carries three-fourths as many tons of coal and coke
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rt lead) as
general merchandise, wherefore (among other reasons) the average rate per ton per mile is a high one Precisely the same tariff may be

* These are not the fares, according to Mr Cary Elwes figures for 1891, but in 1896 they were stated (in *The Engineer*, July 3 1896) to be usual on these vicinal lines.

enforced on two given lines, and yet obviously the average rate per ton of goods per mile may be much lower on one line, which carries a large proportion of mineral traffic, than on the other, which does not. No practical use can be made of such figures beyond the intellectual exercise of discovering a satisfactory explanation of the differences between them.

On the whole, therefore, the comparison between the Company's section of the Rohilkund Kumaon Railway and the Belgian railways cannot be continued beyond the cost of construction. Even in the *least* favourable instances—the *whole* of the Rohilkund Kumaon

Rajputana Malwa Railway it is as low as 38. These are all metre gauge lines, as are the Belgian, but they occupy the position of main lines on the map, and are worked as fairly large systems (see Appendix IV.)

If we want to find short lines with small traffic we must turn to the 2' 0" and 2' 6" gauge lines—the Jorhat (2' 0" gauge), 28 miles long, earning £152 a mile, with a ratio of expenses to earnings of 84 per cent., the Gaekwar's Dabhoi (2' 6" gauge), 72 miles long, earning £200 a mile, with a ratio of expenses to earnings of 60 per cent., the Cooch Behar (2' 6" gauge) 22 miles long, earning £110 a mile, with a ratio of expenses to earnings of 79 per cent., and the Morvi (2' 6" gauge), 94 miles long, earning £205 a mile, with a ratio of expenses to earnings of 55 per cent. No quotation of figures has been made here in regard to the Darjeeling Himalayan Railway, because it is as singular among Indian, as the Festiniog is among English, lines. But it may be mentioned that this hill line is on the 2' 0" gauge, is 51 miles long, cost Rx. 6009, or, say, £3605 per mile to build, earns £749 per mile, and is worked at a percentage of 59 to

e ratio which

a short line,

it so happens

that very often all these small conditions, including the gauge, go together.

There is one very significant factor (to which attention has not

exceed one in each

direction. The supply in either case depends upon the demand, and especially upon the demand of passengers, but the fewer the trains, the longer the trains may be made up, and the cheaper they may be run—a very important matter in the working of light railways. We have a very notable instance of such economical working on the Bengal and North Western Railway, the agent of which cannot (in the table given in Appendix V.) quote an average through speed of coaching trains, because he does not run any, his long trains are

[illegible] mixed or goods; there is no frequent service of light and rapid passenger trains, because there is no demand for such. There is more time, without any practical inconvenience to the customers of the railway, to fill wagons and to give engines a full train load, and here again is a matter to be studied to make light railways pay.

Figures of later date—for the years 1894 and 1895—show a steady, if slight, improvement in the financial results of Belgian light railways

At the beginning of 1895* there were 1013 miles of light railways in Belgium the nominal capital of the Society had reached £3,920,000, and there were sixty five lines in operation, of which the Brussels-Petite Espinette was worked by electric traction (on the well-known "Thomson Houston" overhead system) and the North-Antwerp by horses, all the rest being worked by steam locomotives.

Of four lines that had hitherto been a dead loss, the Deynze-Audenarde not only paid off its previous losses, but actually gave a dividend, the Thielt-Aeltre paid off a portion, and the other two showed some improvement The total loss in working up to date was £3211, which the special reserve funds of each line could cover 2½ times over, and the general reserve, 5 times.

In 1893 only fourteen lines yielded more than 3½ per cent, giving the shareholders a second dividend In 1895 there were twenty three lines able to declare more than 3½ per cent

The total receipts in 1895 were 5,903,465f, or £236,138; the working expenses 4,091,110f, or £163,644, and the net receipts, therefore, 1,812,355f, or £72,494 This makes the ratio of working expenses to total receipts 69 3 per cent, as compared with 71 per cent in 1894 and 72 in 1893

Benefits—As some indication of the general benefit to the country of Belgian Light Railways, the following quotation from Mr Cary-[illegible]

[illegible] been benefited by the [illegible] remarkable instance being [illegible] a great impetus, and has, in its turn, given rise to the establishment of a large number of sugar factories

"Another industry which has notably profited by the increased railway accommodation is that of stone quarrying, several quarries which had been abandoned owing to insufficient means of transport having been re-opened, in addition to new ones started Market gardening has also been successfully encouraged, and vans specially adapted to the carriage of baskets of fruit and vegetables have been built So great has been the success of the easy means thus afforded to the people of taking agricultural produce to market that a special night train has had to be put on, which enables peasant farmers and gardeners to arrive very early at the market, and to be back again at their homes by 6 o'clock the same morning

* *The Engineer*, July 3, 1896.

"This train has been taken advantage of particularly by growers of strawberries"

While we are upon the subject of the probable benefits of light railway projects, the hopeless endeavour of the sanguine statistician to base a rule upon only one or two factors, where an infinite number of factors are concerned, is illustrated by such a question as the following —

What minimum of (*a*) density of population, (*b*) wealth, would justify the formation of light lines in a given district?

Now, if we are to wait for density of population and wealth in a

causes, which justify such projects

To such a question, however, the National Society manages to give an instructive reply * Their lines are laid in well populated commercial centres, exclusively intended for passenger traffic, but it is impossible to say how many inhabitants are really served by them, because railways of standard gauge already run through the district The energy of the inhabitants must be taken into account, and the trade and industries of the country traversed. For lines intended for both passenger and goods traffic, there *is not and cannot be* any fixed minimum of inhabitants to justify their construction The population may be scanty, but the land may be fertile, promising ample traffic in agricultural produce Or, industries may be tapped which ensure considerable goods traffic Where these inducements are less, the population to be served must be greater On the other hand—and this is still more destructive of the practical value of a question of this sort—it is not impossible to find an agricultural district, such as those served by the Dutch railways, where the population is both (*a*) dense and (*b*) wealthy, and yet the traffic is poor

The problem may be compared to an equation with an indefinite number of terms—

$$x = aA + bB + cC + \quad . \quad .$$

where certain values have to be assigned to A, B, C , representing density of population, wealth, agricultural produce, manufactures, etc , and also certain values to the co efficients a, b c , measuring the actual effect of the factors A, B, C In such a case, how far is an advance made towards a solution of the problem by determining the first and second terms, if we leave the others untouched? We cannot profitably make precise calculations in one particular, and ignore the others, when they all conduce to a large result

Co operation of State and People in working Light Railways — It may not be out of place to make a few remarks upon the part taken by the Government in light railways in Belgium "Railroads,"

* *Bull de la Comm Internat du Congrès des Chem de Fer*, vol IX , 1895

says Professor Hadley,* "insisted on coming whether monarchical Governments liked them or not, and they did so much good when they came that the Government soon decided that they were a good thing, and gave their paternal assistance, either in the form of

State construction" It is due to

work was started as early as 1833

small, however, between 1850 and

1870 ... private lines, until

country Now, as

the whole is prac-

ownership of the

to State aid and State contr

main line system of standard

and is worked by the State The light railway system is much more

is its head, but the monopoly

by the State to the National

company are the State, the

Communes, the Provinces, and private individuals, yet these share-

holders have no part in the ... ors even

being appointed by the State ... lines is

leased out by the Society to ... associa-

tions formed by the local authorities We have here a most interesting combination of the State, a society—which is at one and the same time a private company and a department of the State—and, either as shareholders or working agencies, the people, separately as private individuals or associated as local governing bodies or independent

ways, but they meet on more or less equal terms as officials, and their relations are far easier than would exist in England between a similar company with a light railway monopoly and the great private corporations to which our standard railway system belongs The delegation by the State to the Society of the promotion, construction, and administration of all light railways has made the marvellous development of the latter in Belgium possible, but the application of the same method to the different conditions of Great Britain might meet with little favour

Taking into consideration the actual percentage paid by Belgian light railways, as a whole, and their total effect upon the country districts, M. Colson's opinion † that their organisation had been favourable to their construction but not very satisfactory in regard to their working can scarcely be accepted

* *Railroad Transportation*, by Prof A T Hadley, p 209

† *Bull de la Comm Internat du Cong des Chem de Fer*, 1891,—"La Législation des Chemins de Fer Économiques."

CHAPTER IV

LIGHT RAILWAYS IN FRANCE

CONTENTS —Railways imitated and aided by the State Railway system

ing and even constructing the railways before the companies could be induced to take them up

In France—and, indeed, in all countries but England and America —we discover a dependence upon State initiative and a regard for symmetry and system which are strange to us When an Englishman or American sees his way to a big thing he only asks the State to let him alone, nor does he waste time in considering whether the particular thing he wants will ultimately fit in accurately with some general design, so long as he can accomplish his immediate purpose in his own way, he is content to leave it to others to find a consistent theory to explain his practical success The Frenchman, however, likes to have a symmetrical and comprehensive scheme before he attempts to carry out the details Accordingly, a perfectly planned [illegible] had to [illegible]rward 1842

The State was to contribute rather more than half the cost, private capital the remainder, and the railways were to revert to the State in forty years or so

In 1848 there was a check, but, in 1851, Napoleon III extended the duration of the companies' charters to ninety nine years from that date, in order that their permanent position might be assured and their development encouraged

A few years later, five or six main lines radiating from Paris held a monopoly, each within its own area, of the through traffic, and were not at all concerned to develop local traffic Secure in the possession of the through traffic, they had no inducement to build branch lines for the development of local traffic, the prospects of which were doubtful, and the profits much less remunerative In 1859, however, a distinction was made between the "old network" (*ancien réseau*) of paying main lines and the "new network" (*nouveau réseau*) of less profitable extensions, which the great companies were invited to construct under the most liberal guarantees of interest by the Government, if the lines paid, the companies bought out the Government, and, if they did not, the Government had to make good their guarantee, so that the companies got more profit out of it than anybody else *

The law of 1865 attempted to establish local lines independently of the great companies, and was therefore, quite a new departure The local authorities were empowered to advance money for the construction of cheap branch lines Unfortunately, having been built on the standard gauge, these lines, which were intended to be purely local and tributary, combined, in spite of prohibition, to form continuous routes competing with the main lines They became involved in speculations and expenses beyond their means And, after coming to utter grief, most of them were bought up, either by the State or by [illegible] into the main line system

[illegible] new life to light railway de[illegible] as well as to local railways (*chemins de fer d'intérêt local*), by a *tramway*, in French legislation, we must understand a railway laid wholly, or for the most part, on a [illegible]

[illegible] affecting the gradients, curves, number and speed of trains, rates, etc, are separately prescribed in the specification for each railway (a [illegible]

[illegible] speed on light lines is limited by the Prefect Women are frequently

* *Railroad Transportation* by Arthur T Hadley

employed Examination of stock on running trains is not enforced Block instruments and telegraph are not required, telephonic communication, which is cheaper than telegraph, is permitted, these single lines may be worked by staff Triangles replace turn tables The length of trains, by the decree of 1889, is limited to sixteen vehicles, but a buffer vehicle between the engine and the first passenger coach is not required, nor, if the train be fitted with the continuous brake, need there be a special brakesman in the last vehicle, or a fireman on the engine Three trains daily each way are the usual minimum of service with a subsidy for extra trains Stations and approaches need not be lit until fifteen minutes before an evening train is timed to arrive Such are the simplifications of working which may be inserted in the specification for a local line

The majority of local railways have adopted the one metre gauge, but this does not determine their *differentia* from ordinary railways, several of which have been constructed on that gauge The distinction between them is rather administrative and financial

Light Railways under Local Management Subsidised by Aid from State and Main Line Companies—The ordinary railways are subject to State administration and centralisation The local railways are under departmental or local administration and all powers reserved in the specification to public authority—such as approval of the project the arrangement of time tables, and the classification of rates—are placed in the hands of the Prefect of the particular Department without reference to the Minister of Public Works

The relief afforded by administrative decentralisation, however, has done less for the growth of light railways than the financial facilities introduced by the law * It deals only with the terms on which State grants may be made, leaving the actual details of the concession to be determined by the local authorities State grants may be made without imposing any other obligations These subsidies take the form of annuities amounting to not more than 5 per cent on first cost capital, and must not increase the gross revenue of the railway beyond 10 500 francs per kilometre (£676 per mile) of broad gauge line, 8500 francs per kilometre (£547 per mile) of narrow gauge line, or 6500 francs per kilometre (£418 per mile) of tramway The State will only
that the local authorities who
the co operation of other inter
subsidy, and, if the latter takes the form of capital or works, instead of an annuity, it is equated as an annual charge of 4 per cent, including amortisation Under the law of 1865 the public aid was given to capital, under the law of 1880, to revenue

By making its subsidy an annual addition to revenue, instead of an immediate addition to capital for construction, the State hoped to strengthen the working of the line, and at first the Departments

* "Expos de la Question de la Législation des Chemins de fer Economiques" by M Colson,—*Bull de la Comm Internat du Congrès des Chemins de Fer*, 1891

followed the same course, with the same object. Unfortunately, the lines thus established discovered in such conditions no great inducement to improve their working. The concessionnaires found their profits in raising the capital and promoting the construction of the lines; after that, they were guaranteed interest at 5 per cent. of capital, and knew well that, even if they exerted themselves to the utmost in the development of traffic, they could never *earn* that minimum of revenue.

It became very evident that, if the system of annual subsidies was to prove satisfactory, the working expenses should be calculated in accordance with a revenue formula, not a capital formula. In many cases, however, the effect of some of these formulæ was to content the working agency with such traffic as offered and could bear high rates; they promised no further remuneration for developing traffic by a reduction of tariff, or for attracting more business by multiplying and improving the service of trains.

Another suggestion occurred to the Departmental authorities. If, with their superior credit, they could borrow money at a much lower rate of interest than had to be guaranteed to concessionnaires, why should not the Departments themselves raise the construction capital, and force the concessionnaires who took up the lines to seek their profits in an expansion of revenue, enterprising management, and economical working? M. Colson's chief fear was that the Departments, unless checked by higher authority, might go too far in that direction. The concessionnaires should at the very least furnish the rolling stock; for, if [illegible]
what was to prevent [illegible]
they got into difficult[illegible]
able security, which means tying up money instead of utilising it. When this system of Departmental construction is adopted, moreover, the working agreements are for comparatively short periods; and, in order to ensure the proper upkeep of the way and stock for which the Department has paid, it becomes necessary to deduct, from the share allotted annually to the concessionnaires, a certain amount to be devoted to the formation of a maintenance reserve fund. Such, too, was the experience of the Belgian National Society.

The custom of making good deficits on working expenses was gradually discontinued. If the gross receipts were less than the working expenses, they were handed over to the concessionnaires up to a certain figure. There was thus a limit to the charges falling upon the Departments, and little inducement to promote lines which were not likely even to pay the cost of working. As, however, the line improved, and the receipts grew, the Departments would very naturally want a fair share of the profits, and here they were exposed to [illegible]

prosperous the line might become; if, on the contrary, the conces-

sionnaires did not get enough of the surplus, they would not do their best to increase it The concessionnaires to whom the line was leased might see their way to a reduction of tariff, an improvement of facilities, and an expansion of traffic which would benefit the passenger, the shipper, the district and the country at large, yet the fraction of the surplus allotted to them might not repay them for the trouble, the cost, and the sacrifice involved The contradiction in terms of formulæ based on gross receipts seemed an insoluble difficulty Experience had not yet stamped with its absolute approval any of those formulæ which endeavoured to combine, with a division of receipts, a due valuation of the nature of the traffic and the conditions of working In 1892, however, the year after M Colson's paper was published, M Considère enunciated a formula which won his warm approval, and the discussion which ensued between these two distinguished experts will be referred to in some detail later on

In regard to the formation of capital by a company holding a concession, the law of 1880 required that the issue of debentures should be subject to the authority of the Minister of Public Works, and that, only in special cases where the solvency of the promoters was beyond question, should the amount of debenture capital be permitted to exceed that of the paid up share capital.

The burdens laid upon the concessionnaires of State subsidised local lines in the way of public services, although not so great as those borne by ordinary railways, were sufficiently heavy, including as they did the free carriage of mails

The law of 1880 with its promise of fewer risks, but smaller profits, seemed to favour the formation of local companies by those whose property or business would be likely to benefit by a railway passing through the district It appealed less to outside promoters or contractors, who, if they take up schemes in various parts of the country, like to be able to consolidate their management under one common direction The effect of the later and more prudent policy of limited subsidies has been to induce the Departments more and more to take the construction of local lines into their own hands, and then to lease out the working This, however increased the charges upon the Departments, and once more opened the way to intervention on the part of the great companies in some cases

No doubt, the interest of a great company's main line in the promotion of a tributary local line would seem to be more immediate than that of the State, which could only find compensation for its assistance in general, indirect, and even remote gains No doubt, also, the State should only take action after those who are more immediately concerned have failed to do their part But all along the great companies had shown no inclination to take the lead in the development of minor railway connections, and it was not until there was a reaction against the tendency of the law of 1880 that the assistance of the great companies invited notice

The Northern has bought up some branches which could not pay

their way, capital has been advanced by the Northern and Eastern,
the Southern, to tributary lines
junction facilities to light lines at
ratio of the light line's share of
expenses to that of the main line is as the traffic units of the light line to the sum of the traffic units of both lines

Main lines working light lines sometimes take from earnings only their actual expenses—cost of maintenance, rolling stock, fuel, and the staff actually resident on the line—requiring nothing on account of general charges or station rent This is very much the sort of lenient treatment which the (2 6" gauge) Cooch Behar (native) State Railway in India received from the Eastern Bengal (Government) State Railway, actual expenses only were charged, and the services of the superior staff were rendered gratuitously

Through rates and through services between the great lines and these branches do not prevail M de Backer* argues that through consignment is only beneficial when it is accompanied by a reduction of rates, that this means a decrease in the fixed charges, and that this loss falls upon the smaller line, since it has to do all the work—
—which these fixed charges
feeder line a rebate per pas
of passengers brought to the main line, but, says M de Backer, "this would seem to be exceptional, however, it shows so keen a sense of justice that it deserves marked attention"

We may sum up in a few words the relations which have hitherto existed in France between these light railways on the one hand, and the State, the Departments, and the great railway companies on the other At first, as we have seen, the promoters constructed and equipped the line at a certain cost, and the State and Department paid interest on that at a rate which is far higher than the present market rate, and then the promoters received, for working the line, a constant sum *plus* a percentage of the gross receipts, while, if the latter fell below a certain figure, the State and the Department had to make up the deficit This system of guaranteed interest was too extravagant to be continued, and the later system was for the Department to build the line, and then to lease the working of it to a contractor, whose remuneration is determined by formulæ designed to make him personally interested in the development of traffic

The Financial Position of Light Railways—In 1894 the con

* *Bulletin de la Commission Internationale du Congrès des Chemins de Fer*, 1891

shape of guarantees on these local railways and tramways, and M
the construc
which we are
local interest
ion was likely
to add considerably to liabilities which were already sufficiently serious

The interesting but discouraging "Report on the Tramways of the Charente Inferieure," drawn up by Mr Stovin Warburton, Her Majesty's Consul at La Rochelle,† although it deals in detail with the light railways of only one Department, takes a most unfavourable view of all. Unfortunately, the subject of light railways in France was still too controversial to enable M Hanotaux to express a pronounced opinion upon their administration, and Mr Warburton's report is the only one published If, as he says, the carts really cut out the railway on the very same roads it must be a very bad case But it is so he says that agricultural produce is preferably carried by cart to market towns ten or twelve miles off Difference of gauge between the main and light lines must be largely responsible for this

The reader will remember that the term "tramways" means such lines as we are concerned with, as Mr Warburton explains, and the report deserves quotation *in extenso* —

"During the past year there has been a considerable amount of tramway construction in this district, and as the subject is one which has attracted a good deal of attention in our own country of late,

well as on the

light railways

or not

"Any line that runs for more than two-thirds of its whole length on or along the sides of the public roads is a tramway, and one which does so for a lesser distance is a railway

"In this Department they are constructed for about 30 per cent of their length on lands purchased for the purpose, and for 70 per
erefore, not being able to show the
tramways, are classed as railways,
the tramways of the Charente
Inferieure

"The formalities necessary before the construction of the lines is permitted vary also according to the nature of the ground on which they run

* *Revue des Deux Mondes* January 15, 1896

† *Reports from Her Majesty's Representatives Abroad on Light Railways* (Commercial, No 9 1894)

"If they are made (wherever they follow the roads) on those which belong exclusively to the Department or the Communes, the Council General of the Department can authorize their construction If, on the other hand, any part of them runs along a road belonging to the State, such as a national road, or the wharf of a maritime port, the concession can only be obtained from the State, and this last is the case with the tramways of the Charente Inférieure, which have been authorized by a Decree from the President of the Republic

"The cost of making the lines is then paid by the State and the Department, here each provides one half, but the latter has to find the money in the first instance, as the State contribution is not given in cash, but in the form of an annuity spread over a term of fifty years

"This is how the matter was carried out here The Department is the paymaster, and advertises for a contractor willing to construct the lines and also to work them during the whole of the concession, which is for fifty years, engaging to repay him the actual outlay incurred, provided it does not exceed a maximum sum agreed upon which in this instance is fixed at £2735 per mile, and includes cost of land purchased, running stock, and everything else

"But the contractor does not receive the whole sum in cash, only being paid three fourths of it, the remaining fourth, being considered as a contribution from him, is deducted from the total sum due, according to his tender, and he is allowed interest on it at the rate of 4 per cent until his concession expires

"The working of the lines is entirely at his risk, but a calculation is made when giving out the contract as to the probable cost of maintenance and working as well as of the probable receipts

"I am informed that here the estimate agreed upon between the Department and the contractor was that it should be put at £76 per mile plus two thirds of the gross receipts

"The tramways of the Charente Inférieure are intended for the transport of agricultural produce, goods, and passengers, the width of gauge is nearly 40 inches, which has been chosen as likely to be the most useful size, the locomotives weigh 15 tons, and the wagons can carry a load of 10 tons, so that practically they are railways running along the roads for most of their length

"Having described these lines, which are similar to others lately made in different parts of France, the question naturally arises as to the benefit derived from them by the districts into which they have been introduced, and on this subject, having consulted persons competent to form an opinion, I have found it to be generally unfavourable

"There may be instances in which these lines have been a success either financially, or by developing the resources of the district to such an extent as to make up for the loss to the public purse which they generally involve, but I believe them to be very rare, and I

should require very strong evidence that this was so in any case before I could credit it

"It is rather soon to pass a judgment on the services which the tramways of this Department may eventually render, but at present I cannot see that they have any chance of doing so to an extent which can ever compensate for the amount of money spent on them

"They run through an agricultural country principally, so that it is to persons engaged in this occupation we should expect the principal benefit to accrue, but I believe that they will be very little used by most of them

"The line passes by hundreds of farms of moderate size (say, from 20 to 200 acres), mostly tillage, which necessitates the use of horses and carts, several of which are generally kept on each farm

"The farmers have produce to sell, but it is generally sold at the different market towns for ten or twelve miles round, and delivered at the buyer's house

"The tramway only runs from one point to another, and if it passes through a certain number of market towns, it leaves a far greater number equally near to any particular farmer untouched, so that in their case it is of no use to him at all

"But even when it runs to the exact place to which he wants to [illegible]

as the district is not a manufacturing one, or sufficiently populous to provide the amount of goods or passenger traffic which would enable them to pay the expenses of working, it is not easy to see what advantage will be derived from them except to a very limited number of persons

"I believe this to be the case in most of the tramway lines which have hitherto been constructed (in a greater or less degree), and it will [illegible]

and for commercial reasons

"If the arrangement by which the funds are obtained is looked into, it will be seen how great an inducement is offered for getting up undertakings of doubtful wisdom when this can be done at the public cost

"In this case, half the charges are paid by the State in the first place, which would present some difficulty if the money had to be

paid down in cash, but the objection to providing so large a sum at once is got over by making it an annual payment extending over fifty years

"The Department naturally wishes to profit by the outlay of this large sum, of which it only pays an infinitesimal part, and in order to do so has to provide the same amount, which it is able to do without inflicting on itself any additional taxation to signify, by borrowing the total sum required at a very moderate rate of interest, which during fifty years will be in a great part paid by the Government annual grant, so that till the end of that period nobody will be much the worse off This would not be so if they had to make up any great loss on the working of the lines, but this is guarded against by the arrangement made with the contractor to work as well as construct them, by making him subscribe one fourth of the capital, and by paying him the interest of this sum during the period of the concession

"Of course, this increases the cost of the undertaking, as he must consider it in his tender, but if it does, it also increases the half paid by the State and the annual payment in lieu of ready money

"It does not seem to me very surprising that, under the circumstances, every part of the country should wish for tramways without looking very closely into the question of whether they are likely to benefit the rest of the country at some future time, for there can be no doubt that they benefit some persons at once, and the expenditure of a large sum of money is always popular in a district when the tax payers are not called on to pay more on account of it

"I have read a great deal of correspondence during the past year as to the desirability of constructing tramways at the cost of the State or county districts in England, and the advantages which would result to the country generally from an expenditure of public money in this way

"On this subject I am not competent to form an opinion, but one argument used by the advocates of it appeared to me a very fallacious one

"It was, that it had been done in France on a large scale for some years past, and that as most of the lines did not work at a profit, the direct loss to the State must be counterbalanced by some indirect [illegible]

difficult, and that if such proof had been required here many lines would never have been constructed

"Persons who wish us to follow the example of this country should remember that here it has been for many years the practice for the State [illegible]

" [illegible]

grant

money can be so spent in a particular district

"In these Departments bordering on the sea, millions have been granted by the State for making and improving seaports and for other maritime works of little advantage to the inland population, which expects its share of whatever is going in the shape of Government aid, and will insist on having it.

"Then the political question steps in, and these districts have Deputies and Senators like other places, whose first duty is to their constituents, and if they neglected it, and were not able or willing to secure this share for them their places would be very likely to be taken by others possessed of more energy or more influence

"The electors of a district consider that they are the best judges of what is good for them, and it seems a hard case to refuse a grant for a tramway on the ground that it will not pay if they wish to have it, when their neighbours in the same Department have been given sums five or six times as large for other undertakings which pay no better

"I believe that this was the case here, and that some prudent persons in other parts of the Department did at first oppose the tramway scheme as a waste of money, but were met with the answer, "You [illegible] from [illegible] nt of [illegible] that people are not so anxious for them as they were

"I am told that many lines which had been projected will not now be carried out, and although the mere finishing of the systems already begun, and which cannot be stopped, may amount to a considerable mileage per year until they are completed, I have reason to believe that after this year tramway construction will show a considerable falling off in this country

"An experienced engineer, who supported the tramways of this Department, informs me that since seeing their working, he has entirely changed his mind about them, and will never again vote for a steam tramway in rural districts unless it is entirely constructed on land purchased, and does not run anywhere along the public roads

"My informant considers that in order to justify the outlay incurred in making tramway lines, every mile of their route should be able to feed them with light or heavy traffic in proportion to their cost of construction and working expenses, and that in order to fulfil this condition they must be made in one of two ways —

"1 Cheap to construct and work, and in this case they should be only what used to be known as a tramway, viz, a line running for all its length along the public roads, with light rails, carriages, and wagons, which enables a service to be kept up of carriages running frequently at small cost

"This kind of tramway requires to be worked by horses, or by engines of a lighter and more economical build than any at present

paid down in cash, but the objection to providing so large a sum at once is got over by making it an annual payment extending over fifty years

"The Department naturally wishes to profit by the outlay of this large sum, of which it only pays an infinitesimal part, and in order to do so has to provide the same amount, which it is able to do without inflicting on itself any additional taxation to signify, by borrowing the total sum required at a very moderate rate of interest, which during fifty years will be in a great part paid by the Government annual grant, so that till the end of that period nobody will be much the worse off This would not be so if they had to make up any great loss on the working of the lines, but this is guarded against by the arrangement made with the contractor to work as well as construct them, by making him subscribe one fourth of the capital, and by paying him the interest of this sum during the period of the concession

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"Then the political question steps in, and these districts have Deputies and Senators like other places, whose first duty is to their constituents, and if they neglected it, and were not able or willing to secure this share for them their places would be very likely to be taken by others possessed of more energy or more influence.

"The electors of a district consider that they are the best judges of what is good for them and it seems a hard case to refuse a grant for a tramway on the ground that it will not pay if they wish to have it, when their neighbours in the same Department have been given sums five or six times as large for other undertakings which pay no better.

"I believe that this was the case here and that some prudent persons in other parts of the Department did at first oppose the tramway scheme as a waste of money, but were met with the answer, "You have got millions for your district and you want to prevent us from getting a few hundred thousands for ours.

"I think, however, it will be found that owing to their want of success tramways are going out of fashion in this country, and that people are not so anxious for them as they were.

"I am told that many lines which had been projected will not now be carried out, and although the mere finishing of the systems already begun, and which cannot be stopped, may amount to a considerable mileage per year until they are completed, I have reason to believe that after this year tramway construction will show a considerable falling off in this country.

"An experienced engineer, who supported the tramways of this Department informs me that since seeing their working, he has entirely changed his mind about them and will never again vote for a steam tramway in rural districts unless it is entirely constructed on land purchased, and does not run anywhere along the public roads.

"My informant considers that in order to justify the outlay in c... r route should be a... oportion to their c... in order to fulfil this condition they must be made in one of two ways —

"1 Cheap to construct and work, and in this case they should be only what used to be known as a tramway, viz, a line running for all its length along the public roads, with light rails, carriages, and wagons, which enables a service to be kept up of carriages running frequently at small cost.

"This kind of tramway requires to be worked by horses, or by engines of a lighter and more econom...

in use in this country, but except in or near large towns it can scarcely ever pay

"2 By making it (as has been done here and elsewhere) a railway more or less light, worked by ordinary steam locomotives, capable of moving a large amount of tonnage in heavier trains running less often.

"A line of this description cannot be run entirely along the public roads in this country for several reasons, one of which is that very few of them are wide enough to al
land must therefore be purchased,
has been done here on 30 per ce
mously increasing the cost, and even this has been insufficient, for where the line does follow the highways, owing to their narrowness,

is, I hear, likely to go in damages.

"Again, the working expenses are very heavy, owing to the rise and fall of the ground on the road parts

"*In one section of about sixteen miles the locomotives have to work* the traffic on an incline of as much as 1 in 30, and they are themselves so heavy when fully provisioned with coals and water, that they can only draw a load of two and a half times their own weight

"This does not matter very much at present, there being so little traffic, but if what is one of the arguments in favour of tramway-making proves correct in this instance, and that sufficient traffic is developed to make the line of benefit to the population as a whole, the line will have to be abandoned and a regular railway constructed in its place, entirely on purchased land, so that the steep gradients may be avoided

"I cannot help thinking that it would have, under the circumstances, been wiser to have spent a very small part of the outlay incurred on improving the public roads, which, in this Department, are far from perfect, but then no grant from the State could have been obtained for such a purpose The general impression now in this country seems to be that the solution of the question of rural traffic does not lie in tramways, but in mechanical traction on the ordinary roads, and that the only difficulty in the way is the want of a locomotive suited to them, and which will not be obliged to carry the great load of coals and water which they do at present, this has not yet been constructed, but the experiments lately carried out in France seem to indicate that the difficulty is most likely to be solved by the use of petroleum as fuel

"If this should turn out to be the case, I feel sure that many country districts will regret having saddled themselves with a costly system of tramways which must be paid for some day, even if the burden is not felt at present, and when we remember the enormous indebtedness of the Communes, any addition to it must appear to be a serious matter

"This debt, which, in 1862, amounted to £26 000 000, or 15s per head of the population, had risen in 1890 to £129,000,000, equal to £3 4s per head, and must have largely increased since then owing to the liberal expenditure on public works during the last four years, which has been facilitated by the low rate of interest for loans secured by county or municipal guarantee

"There may be (as I have said already) some lines of tramways which are exceptions to the general rule and have proved a success by benefiting the country generally or paying their way, but I believe this will be found to be owing to exceptional circumstances, such as

ough

and

Toury, but I believe it combines both these advantages to a degree not found elsewhere, and still its earnings have not hitherto been sufficient to prevent loss in the working

"As to others I have never heard anything beyond the general statement that they benefit the district without any facts or figures being given to prove it

This is a somewhat depressing report and it will be noticed that Mr Warburton is very sceptical in regard to the 'indirect advantage to the population at large of such lines

that his point of view is that of

believes only in a scheme that w

official props It will be only fair to quote a few more cheerful figures* r

Luc-sur

Company

Year	Number of Passengers Carried	Total Receipts	Working Expenses.	Surplus
		£	£	£
1893	215 233	6754	5189	1565
1894	256 664	8288	5302	2986
1895		8930	5271	3209

The gauge, 2 feet of this light railway was chosen in preference to that of 2 ft 6 in because the latter was too near the existing metre gauge, a reason which would not of course, obtain in England, and

* *Engineering* Feb 28 1896

has not prevented us from adopting the 2 ft 6 in gauge in India Both at Dives and Luc sur Mer the line touches the Western of France The track is laid mainly along the side of the public road Besides ordinary traffic, there is extra traffic in summer between Caen and the coast, and even in winter, on market days at Caen, a good amount of business is done in passengers, goods, and farm produce from and to the rural districts The smallness of the gauge, and the portability of the permanent way, make temporary extensions easy, and the lines may be run down to the fields during harvest, and shifted as required

The permanent way is of the Decauville pattern, and weighs 89 lbs per yard It consists of rails, weighing 30 lbs per yard, fastened to sleepers weighing 24½ lbs by two inside and one outside rivets, and is laid in sand ballast, topped with gravel and stones Level crossings over roads are paved

Land (which has frequently been a costly item on the liberal valuation of juries composed of peasant proprietors) was free, and there is no fencing

There are fifteen stations—some with sheds only, others provided with a small office—two running sheds and one repairing shop Telephonic communication has been established on the return wire system.

tons They are made open for summer traffic Mixed first-class and

which carries a 10 ton load (a standard gauge load), does not weigh more than 3¼ tons

Since 1893 there has been a reduction in train mileage expenses and latter having been 1s 1s 4½d in 1893 and 1s small line, it is said to th of August, or an average of 2000 per day

Another line on the 2 feet gauge may be mentioned, that from Pithiviers (Orleans and Malesherbes Railway) to Toury (Paris and Orleans Railway) * It was referred to in Mr Warburton's report above

This railway was constructed by the Council of the Department to encourage the cultivation of beetroot and the manufacture of sugar

* Foris on ' Light Narrow Gauge Railway in France" (*Le Génie Civil*, vol xxv, 1894) *Min Proc Inst C E*, vol cxviii, 1894 Foreign Abstract

Its working has been leased to the Decauville Company, the terms being that, in any year, if the gross receipts are less than £116 a mile, the Department shall pay the Company half the difference, if they are more than £148, the Company shall pay the Department half the difference, and, between these limits of gross receipts, no payment shall be made either way The Department hoped also to save something in road maintenance

The line is nineteen miles long, with seven intermediate stations, and six other stopping places where passengers without luggage may join the train The track is laid on one side of the public road, and is not separated from it in any way Most unfortunately, the opposition of the Communes forced the line to make a detour round the villages instead of passing through them At the stations are an open passenger shed and a parcel office containing a weighing machine The conductor issues tickets on the train The gradients are generally about 1 in 100

The rails weigh 19 1 lbs per yard, and are cold riveted to steel sleepers, with six inches of ballast under the sleepers There are two goods engines, compound on M Mallet's system, weighing 9 tons

eighing 7 2 tons
le wagon bogie,
or beetroot, and
The cost was

Important branches have been laid down by cultivators and manufacturers

"Roselly," in *La Voie Ferrée*, has given some interesting particulars* regarding a group of five local lines, aggregating one hundred miles in length, traversing a desolate sandy desert in the Landes, and owned and worked by an independent company, to which the Great Southern Railway has given a guarantee of 5 per cent on capital These lines were opened in 1891 In 1893 the gross receipts were £18,000 (about £3 10s per mile per week), the working expenses £11,000 (£2 3s per mile per week), and the net earnings £7000 (£1 7s per mile per week)

A reference to the short table at the end of the book, compiled from the Railway Returns of the United Kingdom, will show that the gross receipts are very poor indeed It is all the more remarkable, therefore, that the proportion of working expenses to total receipts should be so low as 61 per cent,—about the same as the Festiniog Railway can boast of with nearly seven times as large receipts, and very creditably approaching the figures which we find opposite the

* *Transport*, January 4, 1895

But then the Southern Railway received £32,000 gross receipts on contributed traffic and this traffic was worked at very much less expense than 56 per cent of the receipts, the average percentage obtaining on the system, so that the net revenue due to the branch lines was a ... Southern Railway had to ... he article infers that a ... cent on all traffic con

M Colson*—in his report to the International Railway Congress of 1891—implies that, both in France and Belgium, light railways have been successfully launched, so far as their construction goes but that their working leaves much to be desired

Discussion on the Utility of Branch Lines —The advocates of light railways will find in M Considère s articles† on the utility of branch lines—and in M Colson's criticisms‡—a most valuable demonstration of the claims which such lines have upon the main lines, the inhabitants of the locality traversed, and the community at large, for support and encouragement in return for direct and indirect benefits conferred by them This is indeed, the chief lesson to be learned in our study of the light railways question in France

We are so accustomed to accept as a matter of course—disposed of with the payment of rates and fares—the direct advantages which we derive from railways, that few of us attempt to realise to what extent we are indirectly indebted to them. M Considère has endeavoured (1) to show how largely the main lines profit both directly and indirectly, from light railways which act as feeders to them, (2) how largely the public are benefited by them, (3) to prove that, if rail ways are to render the maximum of direct usefulness to the public, all rates should be reduced to the incremental cost of service (a term which will be defined later on), and (4) instead of guaranteeing a minimum interest on capital or handing over a certain proportion of the gross receipts, to evolve a traffic formula which will induce a working agency to earn its subsidy by the development of traffic, the reduction of rates, and the provision of a liberal train service

Obtaining his data first of all from the special case of nine light feeder lines on the Western, Orleans, and Northern systems and ... Considère s ... of passenger ... one franc, that for every franc of goods receipts taken on the branch the main ...

In M Colson s opinion, however, branch lines develop *local* traffic

—† La Législa

1894

mainly, and their contributions to the main lines have been over estimated by M Considère Without attempting to determine to what precise extent main lines are indebted to branch lines, the late Mr A M Wellington described the position very clearly *—"The reason for the continued and rapid building of branches in spite of their apparent unproductiveness is simply this —They contribute traffic to the main line which, as it is merely an increment *costs always comparatively little to move, and often nothing at all* " If the contributed traffic takes the form of extra passengers or small consignments filling up vehicles which otherwise would be insufficiently loaded, if it supplies a back load, and if it is carried on the main line in the direction of favouring grades, the main line's share of the receipts becomes practically an addition to its net—rather than to its gross—revenue Light railways, therefore, when they act as feeders, are entitled to the most generous treatment at the hands of main line

space, etc , repair their engines and rolling stock at cost price, treat

wagons, allow
on the lead on
te Under the
usual terms, hay might be consigned from Lasingwold in Yorkshire to Hexham in Northumberland or only to a main line station just beyond the junction, and the branch would receive the same in either case

M Considère to the

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h as only one
branch itself,
ht railways is
the State is
equivalent to 5 per cent per annum on their first cost The State, says M Considère, owes this to these local lines The general taxpayer might, therefore be fairly called upon to support them to that extent On the other hand, the general taxpayer may—as will be seen further on in our epitome of M Considère's views—require these lines to be worked at rates which approach the incremental cost of service, in order that he may get full value out of them M Colson doubts that light railways of local interest have any appreciable effect on the public wealth Even that of the great railways must be shared with other agents of modern progress. The utmost we can expect

* *Economic Theor*

from these light railways is one simple and tangible result—the cheaper carriage of certain commodities Any attempt, says M Colson, to count upon indirect benefits as a set off to increased taxation
nto figures
we can do
got in the
district, to estimate more or less correctly—(1) the probable receipts on the branch itself (2) the additional receipts it will bring to the main line, and (3) the direct profit to the public on cost of transport These direct benefits may be compared with the direct expenditure to be incurred, but there we must stop The gross receipts are the most *important item, and they should, M Colson considers, not only* cover the actual cost of working but also pay interest on a portion of the capital. The remainder of the capital may justifiably be furnished by the State and the Department Indeed, considering the privileges belonging to the State in regard to mails, telegraph, stamps, etc, it might contribute as much as one half M Colson values highly the vivifying effect of railway passenger traffic

If, says M Considère, railways are to render the maximum of usefulness to the public, it may be necessary to reduce rates to the incremental cost of service (*le prix de revient partiel de transport*) The application of this term, which occurs so constantly in the discussions of French experts, must be explained The legal or maximum tariff is divisible into two parts—(1) the toll (*droit de péage*), to cover the cost of maintenance of way and works and interest on capital, and (2) the charge for carriage (*prix de transport*) to cover movement expenses, including those connected with rolling stock, the cost of hauling, and the cost of working the traffic The toll amounts to about 60 per cent of the whole charge The actual cost of service (*prix de revient des transports*) is also made up of fixed and movement expenses If from the cost of service we eliminate the quota of fixed charges falling on division, to each unit of traffic, we arrive at the actual increment of cost (*le prix de revient partiel de transport*) due to the movement of a unit of traffic, and to this we will apply the term "incremental cost of service" The investigations of M Baum and other experts justify generally the assumption that cost of service is about the same per passenger mile and per ton mile In discussions on French railways, the cost of service is usually accepted as 5½ centimes per ton or passenger per kilometre (0 88d per mile) and the incremental cost of service as 2 centimes per kilometre (0 32d per mile) The cost of service may differ greatly on one railway and another *On one Indian railway the* average cost of hauling a ton of goods is stated to be 0 14d per mile, on another 0 7d per mile As between one kind of goods and another, the differences in cost of
of the average cost of
use of the term has

Obviously in regard to goods, the cost of service diminishes as we

obtain fuller loads, when the amount of business done in a certain commodity
tend to disa
run empty
and consign
and curves
without bre
conditions the incremental cost of service may be reduced from 2 to 1½ centimes per kilometre (from 0 32d to 0 24d per mile), as in the case of coal trained from the North of France to Paris

M Considere's proposition is opposed to all practical ideas of railway economics The minimum rate—below which a reduction would bring no further traffic of the kind—may be determined by the consumption or by the production, the demand or the supply, of that commodity Like the prohibitive maximum rate, it depends more upon the value of the goods than upon anything else If, in order to reach the minimum, the incremental cost of service is barely covered, other goods which can afford to do so must pay the fixed charges, or the tax payer must make up the deficit

As a matter of fact, in French as in English practice, Solacroup's

has been left to Germany to abandon the *ad valorem* principle of rates and classification in favour of the so called "natural system" (utterly condemned by M Colson) of basing the charge on the weight and volume of the goods A tradesman might just as well charge the same price per pound or per cubic inch for every article in his shop This system ignored the question of varying responsibility, it gave rise to innumerable practical difficulties, and the endeavour to reduce the charges by closer loading—in full wagons, in groups of wagons, or in complete trains—created an intermediate service of middle men called "groupers," who pocketed any nominal saving on the rates

As we have said before, instead of expecting low rates on light railways, we must be prepared very often to pay as much as double the ordinary rates, and this has been already recognised in the schedules of the orders authorizing light railways in England under the Act of 1896

In France, when the Departments determined to construct the light railways but to lease the working of them, various formulæ

The tendency of a formula based on a division of net earnings

Most of the Indian Government agreements with companies working the railways depend on a division of surplus profits (if any) after repayment of guaranteed interest, etc.

In France and Belgium it is usual to adopt formulæ based on a division of gross receipts. The effect of these may be to give the lessee too much on passengers or too little on goods which, although of great importance to the public, are only able to bear a low rate, and there is no inducement to run additional trains. The conflicting interests of the lessee and the public are aggravated, and the usefulness of the railway greatly impaired. A few examples may be given, expressed in English as well as French terms:—

Let F = the working subsidy in francs per kilometre
L = " " pounds sterling per mile
R = the gross receipts in francs or in pounds in each case, then—

$F = 2250f + \frac{1}{4}R$	$L = £145 + \frac{1}{4}R$
$F = 2000f + \frac{1}{3}R$	$L = £129 + \frac{1}{3}R$
$F = 1500f + \frac{1}{2}R$	$L = £97 + \frac{1}{2}R$
$F = 750f + \frac{3}{4}R$	$L = £48 + \frac{3}{4}R$

The constants in these formulæ are obviously such that the subsidy would be equal to the gross receipts when the latter amounted to 3000 francs per kilometre or £193 per mile.

In those known as the Belgian formulæ—

$F = R$ (if R = 0 to 2000f.)
$F = 1500f + 0{\cdot}30R$ (if R = 2000f to 5000f.)
$F = 500f + 0{\cdot}50R$ (if R = 5000f +)
$L = R$ (if R = 0 to £129)
$L = £97 + 0{\cdot}30R$ (if R = £129 to £322)
$L = £32 + 0{\cdot}50R$ (if R = £322 +)

the singular assumption seems to be made that working expenses increase more rapidly when the gross receipts exceed 5000 francs per kilometre or £322 per mile, than when they are below that amount. Accordingly M. Noblemaire (of the P. L. M. Railway) proposed the following—

$F = R$ (if R = 0 to 1000f.)
$F = 250f + \frac{3}{4}R$ (if R = 1000f to 3000f.)
$F = 1000f + \frac{1}{2}R$ (if R = 3000f to 5000f.)
$F = 2000f + 0{\cdot}30R$ (if R = 5000f +)
$L = R$ (if R = 0 to £64)
$L = £16 + \frac{3}{4}R$ (if R = £64 + £193)
$L = £64 + \frac{1}{2}R$ (if R = £193 + £322)
$L = £129 + 0{\cdot}30R$ (if R = £322 +)

The different results obtained by the use of one series or the other is sufficiently illustrated by a few figures.

R	Belgian F	Noblemaire F	R	Belgian F	Noblemaire's F
f	*f*	*f*	*f*	*f*	*f*
1,000	1,000	1,000	6 000	3 500	3 800
1,500	1 500	1 375	8 000	4 500	4 400
2 500	2,250	2 125	10 000	5,500	5 000
4,000	2 700	3 000	12 000	6 500	5 600

In some cases the Government of India has undertaken to maintain, stock, and work a railway constructed by a company for so much pe

by way (

intercha

to make up interest at a certain rate on the actual capital expendi

four terms —

$$I = a + bR^V + cR^M + eM^K,$$

where R^V = gross receipts from passengers, R^M = gross receipts from goods, and M^K = the number of goods tonnes kilometres (corresponding with our ton mileage), and then expands it into six terms—

$$I = a + bR^V + cR^M + dV^K + eM^K + fK,$$

where V^K = the number of passenger kilometres, and K train kilometres The co efficients he proposes are as follows—

$$F = 1000f + 0\ 15R^V + 0\ 25R^M + 0\ 04V^K + 0\ 012M^K + 0\ 40K,$$

or, as we might write it in English equivalents—

$$L = £64 + 0\ 15R^P + 0\ 25R^G + 0\ 04P^M + 0\ 012G^M + 0\ 40M.$$

The effect of the first three terms is obvious They give the lessee a fixed sum *plus* a certain proportion of the gross receipts from passengers and goods The fourth and fifth terms encourage him to increase his passenger mileage and goods ton mileage The sixth term induces him, not merely to run the service of trains required in the specification, but to put on additional trains for goods or passengers

which have been assisted from the public purse—and concurs in his *rejection of formulæ of the $a + b$R type* M Considère's solution of the problem receives from him a warm tribute of praise, but he suggests certain modifications in the formula He would combine the goods and passenger receipts in one term, R Moreover, M Considère s co efficients tend to lower the rates too much, because the lessee is not sufficiently interested in increased receipts, and might even find it pay him to carry certain traffic for nothing An additional train with 60 tons of goods, for example, would add to his subsidy (under the fifth and sixth terms) 1 12 francs, even if the receipts were *nil* M Colson, therefore, would increase the effect of R, and reduce that of a, M, and K, thus —

$$F = 300f + 0\ 5R + 0\ 005M + 0\ 3K,$$

or expressed in English equivalents—

$$L = £19 + 0\ 5R + 0\ 005G + 0\ 3M$$

M Colson is of opinion that, by way of security, the lessee should provide part of the capital and, if the lessee had advanced as much as 10 000 francs per kilometre or £644 per mile, the constant might be raised to 700 francs in one formula and £45 in the other, to give the lessee 4 per cent on his share of the capital It will be observed that if the lessee now runs an additional goods train of 60 tons, the third and fourth terms will only give him 60 centimes for it so that he is obliged to keep his rates high enough to make R a remunerative item, especially if new stock has to be built for the new traffic

idere and Colson has Department of the imary* of an article he letters and order of the terms have been changed for the purpose of comparison—

$$L = £93 + 0\ 3R + 3d\ G + \tfrac{1}{4}l\ M$$

in English equivalents

* *Transport*, Nov 23 1894

CHAPTER V

LIGHT RAILWAYS IN ITALY

CONTENTS.—Railways in each small State—Unification of Italy and purchase of railways by Government—Their operation by companies—The law of 1873—Secondary lines under the law of 1879—The laws of 1881, 1887, and 1889—Remarkable development of tramways—Relative position of light railways and tramways—Various gauges—Signor Alamoli's report—Attitude of the great lines towards light railways—Palermo Corleone light railway—Steam tramways—Occupation of roads by light lines

Relation of Government to the Main Railways.—In Germany, as will be observed in the next chapter, the first railways were built for the local purposes of the different States, and very much the same thing occurred in Italy. With the unification of Italy—which began with the annexation of Lombardy to Sardinia in 1859, and was finally accomplished by the absorption of the Pontifical States in 1871—came the closer connection of the various railways. In the course of a few years they were bought up by the State, and in 1885, State management having been tried and found wanting, the working of the railways was leased to great companies on a system of division based upon the gross receipts—a system which may induce the agency to cut down expenses on renewals and improvements, but is not likely to make it prefer a large traffic at low rates to a small traffic at high rates. Such, briefly, is the position of the main lines, and more need not here be said before introducing the subject of minor lines.

Laws Relative to the Minor Railways.—Under the law of 1873 a certain number of railways were constructed under special conditions of economy and encouragement, such as their exemption from taxes on materials of construction, their freedom from the usual requirements in regard to continuous fencing, their promotion by provincial or communal syndicates, their assistance with an annual subsidy of £64 per mile (1000 francs per kilometre) for thirty five years, etc. This, for example, was the subsidy given to the Torrebelvicino Schio Arsiero line (3′ 1½″ gauge) 14 miles long, to which, however, no corporate bodies appear to have contributed.*

* *Reports from Her Majesty's Representatives Abroad on Light Railways*, 1894.—Italy, No 6.

The Railway Classification Law of 1879 authorised the State to construct 951 miles (1530 kilometres) of secondary lines, on condition that district syndicates furnished 40 per cent of the cost up to £5150 per mile (80,000 francs per kilometre), 30 per cent of the next £4506 per mile (70,000 per kilometre), and 10 per cent of anything above that amount Accordingly, the Arezzo-Fossato line (3 3⅜" gauge), 83 miles long, received $\frac{9}{10}$ths as State subsidy, and $\frac{1}{10}$ths as contributions from corporations The conditions and subsidies of the law of 1873 were extended to such lines, the adoption of narrow gauges was permitted, and these railways might be built on the public roads provided that a clear width of 16 4¾" (5 metres) was left for cart traffic

The law of 1881 permitted the State to afford assistance by subsidies to other lines besides those covered by the law of 1873 The maximum of these subsidies was raised, by the law of 1887, from £64 to £193 per mile (3000 francs per kilometre), and the term of [illegible] to seventy years Such a [illegible] 1½" gauge), 24 miles long, [illegible] contributed a lump sum of £10 000 (250,000 lire) The law of 1889 extended aid by State subsidies to lines promoted by private parties in their own interests

Development of Tramways—But in Italy, as in the Netherlands, the development of *tramways* (by which are meant railways laid on roads) has been much more remarkable than that of secondary railways Failing a special law dealing with tramways, their position is to some extent defined and recognised by various orders issued by the Public Works Department and the Council of State, as well as by legal decisions Thus a tramway cannot be laid on a road except with the sanction of the road authorities Higher authority cannot override lower authority which maintains part of the roads to be occupied The tramway must not interfere with ordinary road traffic, as soon as carts and carriages cannot use the top of the tramway the line becomes a railway The road authorities surrender no part in the possession of the roads to the tramways, if the roads, to suit the tramways require improvement or alteration, the road authorities execute this themselves The spread of tramways in Italy [illegible]

Railway legislation does not hamper tramways They come under legislation affecting steam engines, however, and in this way the Minister of Public Works has been able to regulate sufficiently tramway construction and working Thus there may not be more than 4, 5, or 6 vehicles on a train, maximum speed may be fixed at anything between 9⅓ and 15½ miles (14 to 25 kilometres) an hour, 11 miles (18 kilometres) being the usual maximum, at certain places the trains may be restricted to a foot pace, occasionally the platelayers

* *Bull de la Comm Intern at du Co g des Chemins de Fer*, 1891.

may have to line the road from point to point, but a troublesome and costly requirement of this kind is seldom enforced In regard to the tariff, a most important matter, the working agencies are allowed a very free hand, no maxima even, in some cases, being prescribed

Tramways do not seem to receive large subsidies They may be compelled to carry the mails free, but, being classed as road undertakings, they escape the taxes which weigh so heavily upon the railways

Relative Position of Light Railways and Tramways—*It was* anticipated by M Colson that a law, which had for some years been in contemplation, would be passed by the Italian Parliament, depriving tramways of all the advantages due to their decentralisation bringing them, like the light railways, under central control, and placing them under almost as stringent conditions as the normal railways In the case of tramways the clearance between the vehicles and houses fronting the side of the line was to be fixed at 2 ft 7½ in (0 80 metre) The speed was not to exceed 15 miles (24 kilometres) an hour by day, and 11 miles (18 kilometres) by night If the maximum speed did not exceed 12½ miles (20 kilometres) an hour, the line was to be exempted from payment of the fast train tax, and only liable to the usual 2 per cent levied on freight carried by slow trains, but the other lines would be taxed like the normal railways The five centimes stamp duty on tickets, however, was not to be exacted for shorter distances than 6¼ miles (10 kilometres) Direct management by the Departments and Communes was to be prohibited. The concession was to terminate at the end of forty years as a maximum limit Maximum rates and fares would be fixed by the Government who would reserve entire control of the working

Light railways would be dealt with under the same law Concessions for these would be granted by the State, even when they were to be laid wholly or partly upon ordinary roads, but this occupation would require the consent of the local authorities The maximum term of such concessions would be seventy years, or, if three fourths

to be marked off so as to leave a clear width of road of at least 16 ft

the working, and prescribe the time table

The proposed law would authorise the Government to subsidise the

lines in terms of the law of 1889, and require the districts and persons interested to furnish similar assistance, in the form of annuities to date from the opening of the lines for traffic

If the law passed, the classification of existing lines as tramways or as light railways would come under the consideration of the Govern ment, and concessionnaires were greatly alarmed at the prospect of their tramways being reclassed as railways, and burdened with additional taxation accordingly The proposed law would be a com plete reversal of the policy of decentralisation which had been so favourable to these lines, and would bring the tramways under the same regulations as applied to light railways, which—as M Colson

ines

railways—

metre), and

1 8[1] (0 75,

0 95, 1, 1 10, and 1 435 metre)

According to Signor G Adamoli,* the Naples Nala Baiano received no contribution either from State or corporation, but is a very paying concern All the others (except the Turin Rivoli line to which the *Province of Turin contributed*), received a subsidy from the State Most received assistance from interested corporations as well

The tramways, constructed and worked at the expense of the concessionnaires, are not obliged to furnish such returns as would indicate what profit they make

While unable to give figures relating to the increase in trade and produce due to light lines, Signor Adamoli observes —"The fact, however, that none of the grantees has been under the necessity of sus pending or giving up the undertaking, and that none of these lines has afforded the least reason to suppose that, owing to absence of profits, it may be eventually closed, leads to the conclusion that such railways have yielded good results to the localities traversed, and those who have constructed them."

Yet

railway

grievou

up by

powerful working companies (the Adriatic and the Mediterranean) When those leases were made out, the great railways were expected to do wonders for the wealth and prosperity of the country As these anticipations failed, so the great railways became suspicious of competition and injury everywhere On the contrary, it is argued, the effect of these light lines has been contributive, not (or in but few cases) competitive Yet, even those light lines which act as branches and feeders are said to be treated by the main lines in most step motherly fashion They are looked upon as mere underlings, and the assistance afforded them takes such doubtful forms as through book

* *Reports from Her Majesty's Representatives abroad on Light Railways*, 1894

† *Bull de la Comm Internat du Cong des Chemins de Fer* 1895

ing, a burden r ... to the public and accompanied b ... loss falls mainly upon the poor ... ion work covered by the e fixed ... comparatively un important on long distance traffic, their loss easily swallows up the short-lead share of a through rate which is allotted to the branch Interchange of rolling stock and through rating as between two great lines, are all very well but the prov ... the small line is a heavy expense, wl ... marshalling, transhipment, haulage, ... branch is indefensible

The Palermo Corleone Railway in Sicily is a light line on the 3 1½" gauge, 42 miles (68 kilometres) long, to the capital of which (according to Mr Adamoli's Report) the State contributed 60, and the corporations 40 per cent Interesting details of this line are given by Mr R J Money,* some of which may be quoted —

Width at formation level, 11 6"
Steel flange rail, 40 lbs per yard
Red oak sleepers, 5 6 by 7 in by 4½ in
Minimum depth of ballast under sleepers, 4 in
Running time, 42 miles, including stops, 3 hours 50 minutes = 9¾ miles per hour
Running time, 42 miles, excluding stops, 3 hours 27 minutes = 11 miles per hour

Metal bed plates were laid between rail and sleeper at joints and throughout sharp curves, and their number has since been increased, the plates are pierced for two spikes

The first and second class carriages (each with 16 seats longitudinally) and the luggage vans weigh 3 tons empty and 7 tons full The four wheeled wagons weigh 3 tons empty, 9 tons loaded to full capacity, and 6 tons loaded with general goods the corresponding weights for bogie wagons are 6, 18, and 9 tons respectively Thus, two four wheel wagons, with 6 tons dead weight, will carry 12 tons of general g ... w ... e ... r ... which is, of course, in favour of the latter

It appears that the engine loads, with three axles coupled, vary from 45 or 50 tons on a maximum gradient of 3 9 per cent to 100 or 105 tons on the level

Tank engines are used, diameter of cylinders, 12½ in, stroke, 18 in, axles, 3 coupled, 1 pony, rigid wheel base, 6 ft, diameter of wheels, 2 10½" and 2 ft, heating surface, 495 sq ft, weight, loaded, 24 tons 6 cwt, greatest axle load, 6 tons 4 cwt, gross load

* "Light Railways" by Mr P J Money, *Min Proc Inst C E* vol cxxiv

hauled up maximum incline of 1 in 25 50 tons, builders Messrs Hawthorn Leslie & Co

Mr Money gives figures also for the standard gauge main line Sicilian Railway some of which may be arranged so far as possible, for comparison —

Details	Sicilian Railways Main Lines	Palermo Corleone Railway
Length of line on level	20 per cent	12 per cent
gradient of 1 in 200 or less	20	14
1 in 66	39	14
over 1 in 66	21	60
Length of straight line	50 per cent	5[illegible] per cent
Curved line over 500 metres (1640 feet) radius	20	14
500 metres radius or less	30	4[illegible]
Maximum gradient	1 in 31 5	1 in 25 6
Minimum radius of curves	492 feet	230 feet

On the main lines the allowance of coal was 0 27 kilogramme per [illegible]

	Kilogrammes
Locomotive kilometre	4 00
[illegible]	30 00
[illegible]	15 00
[illegible]	60 00
Carriage kilometre	0 60
Loaded wagon (2 axles) kilometre	0 70
„ (4 axles) „	1 40
Empty wagon (2 axles)	0 35
„ (4 axles)	0 70
Hour shunting = 4 locomotive kilometres	

Women at a monthly salary of only 5s to 9s protect the level crossings and signal the trains on the Palermo-Corleone line

For the first four miles from Palermo the railway runs alongside and on a level with the highway separated only by a low stone wall, 9 to 15 inches high serving rather as a boundary and to hold the

ballast than to protect the road traffic "Although," says Mr Money, "there is considerable traffic on the highway, both in carts and foot passengers, no difficulty is experienced in working the railway on these four miles" Nor is there any difficulty on the Wisbech and ... n many light lines in India on the Italian roads occupied ... Money s remark unnecessary were it not for the opposite view held by many of the British public

Steam Tramways—Of "steam tramways in Italy"—as distinguished from such light railways as we have just been discussing—Signor P Amoretti has given us an interesting description *

There is quite a cluster of these about such centres as Padua, Mantua, Bologna Piacenza Turin, and especially Milan Altogether, there were about 1875 miles of steam tramways in Italy in 1895, and most of them according to Signor Amoretti, were on the standard 4 8½" gauge On the other hand, it is puzzling to find in Signor Adamoli s list only one standard gauge tramway (the Naples-Puzzuoli Tramway), and only 287 miles (461 744 kilometres) of tramways altogether Evidently the term has been differently applied by each of these gentlemen, difficulties of this kind are constantly cropping up in the study of light railways

A remarkable development of lines, originally local and isolated, into a connected system with through and cumulative working, has taken place in many parts, especially in Lombardy In some cases goods can be carried right through by tramway, without transfer, for more than 100 miles On the tramways around Pisa, and on others, railway wagons are freely worked About 36 companies, operating 1365 miles of tramways, form the Italian Tramway Association

Of narrow gauges adopted on the tramways, the following were mentioned a few pages back, having been gathered from Signor Adamoli's list—2 5½", 3 0½", 3 3⅜", and 3 7¼" Only the first and last of these are given by Signor Amoretti, who also mentions a 2 11½" gauge as being used

It is absolutely necessary that the top of the rail be flush with the surface of the road, but, in many cases, the metalling between the ... pre ... here ... are ... ated or rather marked off, from the road by spurstones at intervals, which give ... 19 ... by ... opp ... Mr ... centre, and share it with ordinary cart traffic On bridges, between

* *Min Proc Inst C E*, vol cxix 1895, also in *The Engineer*, March and April 1895

† *Min Proc Inst C E*, vol lxx x., Parsons on 'Tramways'

parapets, the minimum distance is 23 11½", which gives also a clear space of 16' 5" In streets, the line is, as a rule, laid in the middle, but in narrower places the line must be laid on the side to leave a minimum clearance to the other side of 15 9"

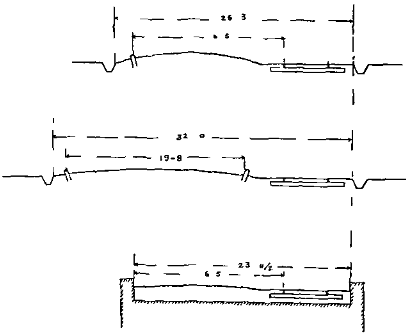

FIG ° —Road Sections, Italian Tramways

Vignoles or flat footed rails are exclusively used They are spiked directly to the sleeper on the straights, but chairs (or rather, it may be presumed, flat bearing plates) are inserted on curves The 36 lb rail has a very narrow head, the 42 lb rail is a wider pattern Only where it is necessary to cross a road, and in towns, are guard rails used to facilitate consolidation of the road metal for the passage of ordinary carts Oak sleepers are used, as this wood is plentiful, their dimensions are 7 3" by 7 in by 4¼ in Guard rails, of similar section to the running rail, are used on curves of less than 165 ft radius The cost of permanent way, with a 40 lb rail, was said by Mr Churchward in 1885* to be about 15s per lineal yard In the towns, point levers are fitted in a box flush with the ground, and can be actuated by the fc
curves are frequently very
as heavy as 1 in 15 It is

* Min Proc Inst C E, vol lxxiv, Parsons on "Tramways"

the utility of the line, more especially for goods traffic, but the object seems to be to construct the line, even with such drawbacks The cro sing places have a loop siding on the off side, requiring an extra strip of land, the greatest length of trains is not much more than 130 ft, so that 359 ft from points to points gives ample room for cro sing, coupling, uncoupling, or other shunting purposes Occasionally a dead end is required as well So far as possible these crossing stations are laid on public ground, as the tramway companies have no powers to take up land compulsorily The station may consist simply of a signboard with the inscription "stopping place,' except at termini The connections with private sidings—leading directly to farms, fruit gardens, dairies, mill, factories, ironworks brickworks, limekilns, quarries, and mines—are numerous, and are such as would be "unattainable on such a general scale by ordinary railways"

"The development of this important branch of traffic resources" —says Signor Amoretti, and the paragraph deserves *verbatim* quotation—' has induced the various companies to do their utmost to facilitate loading and unloading processes Thus, for instance, for the conveyance of bricks and tiles from the extensive works at Beivasco to Turin, the trucks are simple platforms, carrying three or four open cages in whic

On arrival at

thus conveyed

of handling, thus avoiding cumulative charges and attendant per

way station where the tanks are slung by the crane on to platform trucks At their destination the tanks are either emptied direct into a large reservoir or conveyed on carts to the fields These arrangements are undoubtedly of great importance to agricultural districts, and permit of the disposal, at the cheapest possible rate, of sewage matter to much greater distances from the city or town than would otherwise be possible by costly work or machinery"

The engines have generally two axles, on exceptionally steep gradients three The working parts are boxed with a casing which hangs to within 4 in of the rail level In full working order, the engines weigh 8, 16, or, exceptionally, 20 tons The average distance from axle to axle is 5 3", and the diameter of the wheels 1 11" or 2 2¼" Neither condensers nor smoke consumers are adopted Coal

to 4½ tons for covered vans"

All the passenger carriages, and most of the goods wagons, have brakes, chain brakes on the former, screw brakes on the latter Continuous brakes are seldom adopted

Tram trains running at from 10 to 12 miles an hour may have six vehicles attached to the engine. A maximum speed of 11, 12, and even 15 miles is permitted. The first class fare is about 1d., and the second class about ¾d. per mile. At least one telegraphic connection is compulsory between all stations and stopping places along the line. The rates for goods are very low.

The average cost of tramway per mile may be put roughly at £2600, of which £500 is for rolling stock. The gross earnings are about £400, the expenses £300 (or 75 per cent.), the net earnings, therefore, £100 per mile, and the average dividends (*i.e.*, on ordinary shares) about 3 per cent.

In his report to the International Railway Congress of 1891,* M. Colson recognises the use that has been made in Italy of the public roads, and he attributes the prosperity—as he describes it—of the light railways in Italy to the fact that they have not been legislated for, and have not been assisted to a very great extent, since private enterprise has thus had a free field, rates and service have been adapted to actual requirements, and minimum charges and maximum receipts have followed the natural laws of supply and demand.

* *Bull. de la Comm. Intern. du Cong. des Chemins de Fer*, 1891.—"La Législation des Chemins de Fer Économiques."

CHAPTER VI

LIGHT RAILWAYS IN OTHER EUROPEAN COUNTRIES

(GERMANY, AUSTRIA HUNGARY, HOLLAND SWITZERLAND, SWEDEN, AND RUSSIA.)

Germany—Railways local and owned by each State—National interests paramount in Prussia alone—Imperial control of other States limited—Imperial e fects of … lary railways—Local railways … 92 and State aid—Provincia … ys—Cost—Capital—

GERMANY

As, until the Confederation was dissolved in 1866, Germany consisted of numerous States, practically independent in the management of their internal affairs, it is not surprising to find that the early development of railways had no relation to Germany as a whole, but was carried on by each State separately, in accordance with its own particular requirements The smaller States, adopting the policy of State ownership, "actually succeeded," says Prof Hadley,* "in doing what so many of our country towns (in America) tried to do a few years ago by municipal subscriptions, that is, they secured *rail*

* *Railroad Transportation*, p 204

road construction for the sake of local interests, where mere business considerations would not have caused railroads to be built"

In Prussia, however, the growth of the national spirit was impressed upon the development of railways from the beginning In 1842 State aid was granted in the form of guaranteed interest, and the right of taking over the railways after a certain number of years was reserved. In 1848 the State constructed a railway from Berlin towards the Russian frontier, largely for military reasons Henceforward, the State continued to build lines on its own account, and to buy up railway stock. When, in 1870, Prussia welded all the German States (except Austria) into a solid empire, it was Bismarck's desire to establish an Imperial State railway system This was resisted by the component States of the Empire, but, so far as Prussia itself is concerned, it presents to-day—as Prof Hadley says—"the typical example of State railroad ownership" Most Prussian railway servants are members of the civil service, and the railway system

, for business,

e existence as

Government

So far as the railways of each of the other States are concerned, the Imperial Government confines itself to matters of general regulation and supervision The former do not affect those lines which come under the edict of 1878, dealing with local railways This edict recognises standard gauges of 4 $8\frac{1}{2}$, 3 $3\frac{3}{8}$, and 2 $5\frac{1}{2}$" (1 435, 1, and 0 75 metre) limits the maximum speed of trains to $18\frac{1}{2}$ miles (30 kilometres) an hour, imposes less severe regulations in regard to road inspection, fencing, signalling, train service, brake power, &c, and authorises local bodies still further to relax such rules, if necessary, with the approval of the Imperial Government Under the law of 1875, these light railways either receive remuneration for the carriage of the Imperial mails—a service which the great lines have

financial assistance and the application of less stringent rules of working, but declined to lay down more precise rules in the form of a rigid law During the next ten or twelve years several secondary lines were constructed under concessions, but more (and these, as a rule, on the 4' $8\frac{1}{2}$" gauge) by the State which was also busily employed in the acquisition of all the railways The same thing happened in regard to secondary railways in other German States Secondary railways (*Nebenbahnen*)—it should be explained—are lines on the same gauge, and laid with the same description of permanent way as the main lines, but the maximum speed is limited to (40 kilometres or) 25 miles an hour

When, as was seldom the case in Germany, lines were laid on public roads, their treatment was less concerned with concessions than with

the simpler regulations then permissible under the local authorities In Bavaria such tramways formed part of the ordinary railway system. So also did they in Prussia, unless they lay entirely within the boundaries of one Commune, when the State did not interfere.

Light railways (*Kleinbahnen*) in Prussia are more particularly defined and regulated by the law which came into force on 1st October 1892, but no similar law has been introduced into the other States At that time there were in Prussia 83 light railways, 69 of them being for passengers (and of these no less than 61 lay on the outskirts of towns), 5 for goods traffic, and 9 for mixed traffic The standard ... 5½" on 3, the 1' 10½" ... The motive power ... ible on 2, horses on 46, and mixed on others * Within four years—i e, up to 30th September 1896—no less than 129 new light railways had been sanctioned under the law of 1892 Of these, 76 were in actual use, and 53 were in progress

The new law places the light railways under the control of the Post and Telegraph Department, which finds them extremely useful. Financial assistance afforded by the State, the Provinces, and the Communes, in the interests of agriculture and forestry, has caused a rapid development of such lines The State is empowered to lend £650,000 for this purpose Up to the end of January 1897, £120,828 had been allotted and it was intended shortly to increase the amount to £353,053, which would provide for the construction of about 633 miles of light railway There appears to be a great variety in the form and the extent of the assistance given by the Provincial and Communal Authorities

"The one point of agreement," says Lord Granville,† "seems to ...

ment of Wiesbaden the preliminary works (earthworks, etc) are carried out by the Province on the condition that ... themselves to repay half th...

"2 Direct financial assi... ways:

"(a) Hanover, Saxony, Rhine Province, and Schleswig Holstein grant a loan

"In Hanover two thirds of the total capital can be lent at 3 per cent of interest, on condition that at least ½ per cent is put by annually as a sinking fund, the interest always remaining the same

* *Min Proc Inst C E*, vol cxxxi, 1898,—Abstract on "The Development of Light Railways in Prussia

† *Reports from Her Majesty's Representatives Abroad on Light Railways*, No 9, 1894

If the concern yields a net profit, it has to be paid in to the Province to raise the rate of interest or that of the sinking fund

"Saxony lends capital to districts and companies according to the advice of the Provincial Committee

"The Rhine Province lends the whole capital at 3 per cent interest and ½ per cent for sinking fund, on condition that any net profit shall be employed to raise the rate of interest to 3½ per cent, and then to raise the sinking fund

"Schleswig Holstein lends one fourth of the original costs exclusive of the acquisition of the land, without interest, but on condition of a sinking fund being raised

"Westphalia empowers its Committee to lend capital without laying down any specified conditions

"(b) East Prussia pays a certain part (not exceeding 1½ per cent) of the interest paid by the contractors on the actually employed capital, but this is not to be paid for more than forty three years, and the total amount yearly laid out by the Province for this purpose is not to exceed £750

"Saxony undertakes to pay up to 4 per cent for interest and sinking fund on condition that the Province shall rank before all other shareholders

"(c) Silesia grants assistance in the form of a free contribution, to which no condition is attached, except that it shall be repaid if the profits of the railway are sufficient

"Schleswig Holstein, besides the above mentioned loan, grants a free contribution up to one eighth of the original cost, on condition that, if the concern is sold, the contribution shall be repaid with the same proportionate part of the sale money

"Posen and Westphalia also intend to grant contributions, but have laid down no conditions

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their help that the district authorities shall in some way be answerable for the railway

"3 Facilities for the use of the public ways

"Brandenburg allows free use of the public roads to light railways of a generally useful character Saxony to all such undertakings

"The Rhine Province only demands payment for the use of the public roads when the light railway pays a net profit of over 6 per cent, and then it demands payment of 20 per cent of this surplus

"East Prussia does not exact payment for the use of already existing roads, and even in other cases the payment can often be evaded This is the same in Posen

"In the budget for the Royal Domains and Forests for this year, £12,500 were set aside for the construction of light railways and for subsidising the same, so far as these railways are of material interest to the domains and forests, but would not come into existence

without the help of the latter From this fund, up to the present time, five light railways have been subsidised in the Provinces of East Prussia and Pomerania "

With this memorandum of Lord ~
seven light railways only existing
for he has not included those n
treated as ordinary railways, although they might fairly be classed as light railways *They were evidently included in the figures given* above for 1892

In this list are found gauges of 4 ft 8½ in, 1 metre, 2 ft 11½ in, 2 ft 7 in, 2 ft 4¾ in, and 1 ft 11¾ in Of the narrowest gauge we have the greatest mileage, of the widest gauge the greatest number of lines For narrower gauges than the standard, the Prussian law of 1892 recommended the metre, the 0 75 metre (2 ft 5½ in), and 0 60 metre (1 ft 11⅝ in) *

The list furnishes some interesting figures of cost The actual cost of the Stolp Rathsdemnitz line, 11 miles long, 4 ft 8½ in gauge,

cost £2595 per mile The Bromberg light railways, 66 miles long, 1ft 11⅝ in gauge, were estimated to cost £1626 per mile The estimated cost of the Wilkovo light railways, 34½ miles long, 1 ft 11⅝ in gauge, was only £848 per mile

The capital for the lines given in Lord Granville's list was provided by the contractor, the province, the district and the parties concerned, either separately by one, or jointly by two, three, or all four In most instances the contractor supplied the money Referring to the lines already mentioned, it may be noted that the capital for the line from Stolp to Rathsdemnitz was provided, in practically equal amounts, by the province, the district, and parties concerned, that for the line from Bromberg to the cattle market, the Bromberg light railways, and the Wilkovo light railways, by the contractor

Before the law of 1892 was put into force, the provision of light lines was mainly confined to town service, and 83 per cent of them were for exclusively passenger traffic Since then at least three fourths of the new light railways have been designed for town to town communication and mixed traffic It is anticipated that electricity will be largely employed as the motive power, and it is already (up to Sept 1896) used on 38 light railways

It is exceedingly difficult to obtain useful information in regard to results of working According to *Engineering*, 2nd Nov 1894, the light railways in Germany, with a mileage of about 500, mostly

* This gauge is largely used for military purposes. Information regarding curves, gradients permanent way, and rolling stock is given in *Min. Proc. Inst. C E* vol cxvi 1893 94 —"Experience of the Prussian Railway Dept in the Construction and Working of Narrow Gauge Railways."

narrow gauge, earned gross receipts of £400 a mile, and paid from 2 2 to 2 5 per cent on capital outlay On the Bavarian light railways in 1893 the gross receipts* were £106,601, and the expenses £55,588, or 50 26 per cent, on gross receipts of only about £5 per mile per week These Government light railways are all of standard gauge, 4 $8\frac{1}{2}''$, to take main line goods wagons, but are under separate management about two-thirds of the traffic are goods, and the method of working is extremely econc
Railway, as a particular instance of
is also given by Mr Money, here,
the line was opened in 1888, is of standard gauge, cost £2858 for construction and £269 for rolling stock per mile, employs 30 men, or 1 23 per mile, earns total receipts of £3842 (about £3 only per mile per week), and is worked at a cost of £2636, or 68 61 per cent of gross earnings

between passengers and engine, even for omnibus trains on main lines the conductor might have sole charge of the train sell tickets at stopping places where no staff was kept and look after luggage, the driver and stoker, who worked the engine might also grease the carriages, women might be employed as gate keepers, temporary

signals might not be considered necessary, facing points might not even have point indicators, the stoker might be dispensed with on the engine, mixed trains would, of course, be permissible, trains, being ordinarily limited to 120 axles might be pushed if they did not exceed 50 axles, with a man in the leading wagon, and at a speed not exceeding nine miles an hour, authorised station masters might not be required at stopping places, and the brakes on vehicles (excluding those on the engine and tender) might be one axle in every 12, 10, 8, 7, 5, or 4 on inclines of 1 in 500, 300, 200, 100, 60, and 40 respectively

In some cases, ordinary lines were actually disclassed to take

* Appendix iii., "Money on Light Railways" vol cxxiii., *Min. Proc. Inst C E* 1895–96

† "Exposé de la Question des Lignes à faible Trafic" by J Lewis,—*Bull de la Comm Internat du Congrès des Chemins de Fer*, 1892

larly to opening up new markets and facilitat[illegible] the carriage [illegible] of manure and raw produce, over a considerable area of [illegible]

AUSTRIA.

At first the Austrian Government was inclined to look upon railways with the cold eye of dislike and discouragement. As early as [illegible] however, Austria had a general railway law, such as we did [illegible] until 1845, and after that, for eight years or so until the [illegible] of 1848, the State both built railways and assisted others to [illegible] [illegible] very time when Prussia was [illegible]nment were selling them, and [illegible] For the backward [illegible] [illegible] suffered accordingly in her [illegible]ssia in 1866. A few years of reckless enterprise and speculation followed. Roused at last in 1873, the Government determined, so far as the limited resources of the Treasury would allow, to pursue thenceforward a policy of State ownership and management. From time to time, moreover, railways of a lighter description—officially known as "local lines" (*Localbahnen*) since 1875—were built, under special laws, at the cost partly of the State and partly of private persons. In obedience to popular demand, a law was passed in 1880 to afford further facilities for developing such lines, even without the co-operation of the State, by means of concessions, greater freedom in details of construction and working, rates, service of trains, and speed, permission to lay such lines on public roads, etc. For some years, under the stimulus of this law, local lines were freely built, but the results were not sufficiently remunerative to private capital, and it was only after the law of 1887 was passed that active promotion of these railways [illegible]

[illegible] [illegible]ication and slower speeds, could also be admitted to like privileges—in fact, the [illegible]

[illegible] within the maximum limits were left to the concessionnaires. In the concessions granted to local lines might be included exemption from taxes which weighed heavily upon the main lines, from free carriage of mails, from police charges, from supervision charges, from stamp duties, from the stamping of passengers' tickets, etc. Junction facilities were afforded to local lines connecting with main lines.

guaranteed by the State, and the common use of main line stations was given to them, free of charge If the Provinces the Communes, and private persons contributed a reasonable share of the cost of such lines, the Treasury might furnish subsidies, or State aid might take the forms of grants of land or materials of construction, or of guarantees of gross or net revenue A State main line might work a local branch for less than the actual cost of working the State reserving the right of running State trains over the branch by paying toll

Between 1880 and 1886, under the law of 1880, upwards of 87 local lines were constructed, covering a length of 1491 miles (2399 kilometres) In 1887, as we might suppose, nothing was done Between 1888 and 1893—under the law of 1887—45 local lines, covering a length of 743 miles (1195 6 kilometres), were constructed

The Diet of Styria led the way in 1890 by raising £833,333 (10,000,000 florins) to be drawn upon for the construction of local railways. Either the State or interested parties, or both together, must supply a third of the required capital (in lump sum or by subscription shares) and must guarantee ⅗ths of the interest at 4 per cent on *the capital These provincial lines would be worked if possible, by* the administrations of the main lines with which they connect, at actual working cost, otherwise they would come under provincial management The application of the law is entrusted to a mixed Commission, representing official and commercial interests

The Diet of Bohemia passed a similar law in 1892 The subscription took the form of a guarantee of interest

The Galician Diet followed suit in 1893 but although, by this law, £25 000 (300,000 florins) was, for a period of thirty years from 1894, '

the vi

be left

and thorough examination of each project

A great deal of the above information has been gathered from a note by Herr E A Ziffer in the *Bull de la Com Int du Cong des Ch de Fer*, 1895 The rest of the note is mainly a eulogium of such narrow gauges as 2 6" (0 76 metre or 29 92 inches) Without going too much into details here a few of his facts may be mentioned When a line was to be constructed from Nenhas to Nenbistritz, a distance of 11¼ miles (18 kilometres), it was estimated that it would cost £125,000 on the normal gauge against £95,000 on the 2 6" gauge, and the latter was accordingly adopted In 1892 the Imperial and Royal Railway of Bosnia (2 6" gauge), 166 miles long, showed expenses of £286 against receipts of £531 per mile This railway, with the State railways of Bosnia and Herzegovina, makes up a system 379 miles (609 kilometres) in length, the longest in Europe, of 2 6" lines, the average cost of them up to 1891 was £7065 per mile, the cost of them would have been £12,662 per mile if they had been laid to normal gauge, and they pay interest at about 3 per cent

In Austria Hungary,* the encouragement given to light railways has taken the form of relieving them from the heavy dues charged on ordinary railways, and of affording them special commercial and technical facilities, while the Provinces have backed the policy of the Central Government with actual financial assistance

HUNGARY

The construction of local railways in Hungary began as long ago as 1860, and a distinction was made between secondary lines on the normal gauge and tertiary lines on the narrow gauge

The public roads were either insufficient or in bad repair, and the development of agriculture and forestry much more marked than that of manufactures, increased the demand made by local authorities and private persons for local railway legislation Under such continued pressure the laws of 1880 and 1888 were passed

While an ordinary railway requires a special law, concessions for a local line may be granted in an ordinance by the Hungarian Minister of Commerce for a period of 90 years, and reserving the right of pre-emption

If the line passes through State property the State will contribute to the cost of construction The Minister of Commerce may subsidise the line (in return for carrying the mails) but the subsidy, capitalised at 5 per cent, shall not exceed 10 per cent of the actual cost of constructing the railway For subsidies up to the 10 per cent limit the State Budget may annually be debited with £25 000 The Hungarian State Railways will carry construction materials at actual cost of pocket expenses, will supply engines, etc, from their locomotive workshops at long credit, will furnish rolling stock at moderate rent to those local railways that they work, and are bound to take over (as also are State guaranteed private lines) the working of local railways which connect with them, on the condition that they receive compensation, if actual expenses are not covered Moreover the Minister may demand that the working of a local railway be handed over to a State or State guaranteed railway

The Minister of Commerce may refuse concessions to local lines if those who benefit by them do not contribute 25 per cent of the required capital The municipal and district authorities may also contribute and levy special taxes for the purpose The actual construction capital is fixed by the act of concession, the amount, and the method and conditions of subscription, of the normal capital, the kinds of stock to be issued, the dividends, and fixed interest are defined by the Minister of Commerce The maximum rates are laid down in the act of concession, and reductions may be called for if the

* *Bull de la Comm. Internat du Congrès des Chemins de Fer*, 1891,—"La Législation des Chemins de Fer Économiques"

net profit is as much as 7 per cent per annum three years running, but within the maxima the concessionnaires have a free hand.

In regard to brake power, it will be interesting to quote the table* recommended by the "Union des Chemins de Fer Allemands," and apparently adopted in Austria Hungary —

On Gradients of—		Second Class Lines				Local Lines
		Brake Power Per cent of Gross Train Weight for Speeds in Miles per Hour of—				
per 1000	1 in	15	18	21	24	Up to 18
0	∞	6	6	6	6	6
2·5	400	6	6	7	9	9
5	200	6	7	9	12	12
7·5	133$\frac{1}{3}$	8	10	12	15	15
10	100	10	13	15	18	18
12·5	80	13	15	18	21	21
15	66$\frac{2}{3}$	15	18	21	24	24
17·5	57$\frac{1}{7}$	18	21	24	27	27
20	50	20	23	27	31	31
22·5	44$\frac{4}{9}$	22	26	30	34	34
25	40	25	29	33	37	37
30	33$\frac{1}{3}$	30	34	38	43	43
35	28$\frac{4}{7}$	34	39	44	49	49
40	25	39	45	50	56	56

Telegraph need not be provided if there are no crossing places and no night-running. Three mixed trains a week at fixed times are the moderate demand in the matter of train service. For thirty years (unless after ten years' working they are paying as much as 6 per cent) local lines may be exempted from stamp duties and other taxes, nor do they have to pay for police. Among other burdens, they are (during the first ten years) relieved of the heavy transport

* *Bull de la Comm Internat du Congrès des Ch de Fer*, vol VII, 1892

taxes, which amount to as much as 18 per cent on passengers, 7 per cent on express goods, and 5 per cent. on slow goods

At junction or joint stations, the service of the local line is performed by the main line sometimes at cost price, but gratuitously as a rule All that is demanded of the connecting local line is the provision at its own cost of any necessary new installations Handling expenses are paid by the line that incurs them

Fencing and level crossing gates are only provided if specially required Although the telegraph is not obligatory, it is sometimes adopted as a matter of convenient working, the telephone is more frequent, the road bell signal is dispensed with Point indicators and disc signals are confined to junctions and crossing stations, as a rule, but electric-bell control of points, or interlocking of points and signals may be exceptionally required in the specification, outside points have to be padlocked In mixed trains the passengers are, so far as possible, placed in the rear half of the train, at anyrate not immediately behind the locomotive but a buffer vehicle is only considered necessary under certain conditions of speed and composition of trains Special facilities are adopted for the sale of tickets

The average mileage of local lines (*Vicinalbahnen*) open in 1888 was 1144 (1831 kilometres), and in 1893, 2333 (3733 kilometres), the gross receipts were £245 per mile (1839 florins per kilometre) in 1888, and £284 per mile (2131 florins per kilometre) in 1893

Official statistics show a total mileage of 2326 (3722 kilometres) in 1892, of which little more than 5 per cent was on a narrow gauge 2 ft 6 in (0 76 metre) In this are included sixty local lines, which, with five others under construction, represent capital of £10,696 430 (128,357,161 florins)

subscription is 13 3, of

12 4—total percentage

The remainder, £7,138,777, represents the satisfactory share taken by private enterprise

2 ft 6 in gauge

be remembered

nerally furnished

the rolling stock

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State

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pense of the State railway, (*c*) as proprietors, or in most cases (*d*) under working agreements

The rolling stock belonging to the local lines consisted of 108 engines (0 046 per mile), 236 carriages (0 101 per mile), and 1714 goods wagons (0 73 per mile)

The gross receipts averaged £302 per mile, the working expenses £165 per mile or 54 7 per cent of the receipts. But the receipts varied between such wide extremes as £806 per mile on one line,

and £17 on another, and the percentage of expenses to receipts may be as little as 36 1 or as large as 89 5

The average interest on capital was 3 31 This seems very sati factory, but it "is due partly to the *sufficiently high passenger and goods rates charged*, and partly to the working agreements entered into with the State railways According to these agreements the State receives a fixed sum per passenger mile and per ton mile of goods Hence in every case some profit cannot fail to accrue unless the private companies spend sums above and beyond working ex penses properly so called

"In spite of the subsidy provided by the Hungarian State railways by means of working agreements, and amounting to the sum of £25,000 (300,000 florins) at least, still the net proceeds of the local railways are insufficient to meet the interest on preference shares, and the ordinary shares bear, as a rule, no interest" * Of course, one of M Ziffer s remedies for

is an open question

working of the lines,—

by regulations and lac

Mileage in 1892,	3722 kilom
Gauge—	
Ordinary,	1 435 metres
Narrow,	0 76 ,,

"The capital necessary for the construction of secondary railways has, as a rule, been obtained by private enterprise, to which, however, the State, the municipalities, the parishes, and others have contri buted, either in fixed amounts, in subsidies, or by offering some guarantee according to their interest in the railway to be constructed *Such contributions have been made in exchange for ordinary shares*, or, *à fonds perdus*

"The State also remunerates such railways for carrying the mails, either by yearly payments of certain amount in proportion to the services actually rendered, or by arranging an annual average sum payable for a certain series of years

"These annual payments are usually capitalised and discounted by a bank

"There are also instances of municipalities guaranteeing the yearly

* *Bull de la Comm Internat du Congres des Chemins de Fer*, 1894,—"Local Lines in Hungary," by M Ziffer

† *Reports from Her Majesty's Representatives Abroad on Light Railways*

payment of interest and the quota of amortisation of the debentures issued by such railways

"The companies formed for the construction of such railways usually issue ordinary shares, which must represent at least 35 per cent of the actual building capital The balance is then represented by preference shares or preference bonds (debentures)

"The total of the contributions to the actual building capital of such railways represented, at the end of 1892 33 2 per cent of that capital, out of which the State contributed 13 3 per cent, including 5 6 per cent for carrying the mails (capitalised) 7 5 per cent being contributed by the municipalities, and 12 4 per cent by the parishes and from other sources.

e State
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which
unt of

11,772,190 florins (about £1 231 015) whereas the balance of 2,395,490 florins (about £199 625) was given *à fonds perdus*

"The contributions of the municipalities amounted at the end of 1892 to 9,588,442 florins (about £799,036) of which about 25 per cent were given *a fonds perdus*, and the balance in exchange for ordinary shares

"The secondary railways are managed either independently by the companies themselves, or by the State railways on the basis of contracts

"Such railways cannot be looked upon as paying undertakings for the present, especially for the holders of ordinary shares

"It must, however be considered that the ordinary shares are for the greatest part held by the contributors who have greatest economical interest in the construction of the lines, owing to the facilities of communication thereby obtained, and to the consequent increase in the value of their estates

"As to the State contributions, they are counterbalanced by the increase of the traffic of their own lines as well as by the general economical development to be expected in the districts through which the secondary lines pass

"In fact, out of the sixty secondary railways, only eight have paid dividends on their ordinary shares up to the year 1892

"The income of the secondary railways was —

	1891	1892
	Per cent	Per cent.
In proportion to the actual capital	3 12	3 45
In proportion to the nominal capital (excluding the ordinary shares)	4 30	4 61

"The percentage of the deficit, without reckoning the ordinary shares, and only taking into consideration the sums required to meet the interest, and the quota of amortisation in 1892, was 11·09 per cent

"The receipts in 1892 were —

		Kreuzer
Per passenger,	. . . .	1·70 per kilom (About $\frac{1}{10}$d)
Goods, per ton	. .	3·62 per kilom (About $\frac{1}{10}$d)

"Whether, and to what degree, the secondary railways have stimulated the production and sale of dairy products, eggs, fruit, and vegetables and products of other small industries in the districts through which they pass, cannot be ascertained "

HOLLAND.

In Holland, local railways* do not necessarily mean—as in France or Belgium—those which are to a great extent paid for out of the local treasuries and whose very existence depends upon the Provincial and Communal Councils The essential difference between local and normal railways is one of special facilities, and the relief of the former from the regulations for construction and working imposed on the latter by the law of 1875 This relief, afforded by the law of 1878, was partial in the case of those local railways upon which the axle load was limited to 9·84 tons (10 000 kilogrammes) and the speed of trains to 18$\frac{1}{2}$ miles (30 kilometres) an hour, it was complete, when the speed did not exceed 9$\frac{1}{4}$ miles (15 kilometres) an hour These maximum speeds were raised, in 1889, to 25 and 12 miles (40 and 20 kilometres) an hour respectively

The facilities include their release from requirements usually called for in connection with adjoining properties, fencing, details of working mail service, other communications, etc The application of the term "local" to such lines is so independent of any relations with local authorities, so purely one of freedom from stringent obligations, that the great companies have been able to place several of their lines under the easier operation of the law of 1878, and to have them classed as local railways

We may divide them into light railways and tramways The former do, the latter do not (even when of the same gauge), make direct junction with the main lines.

The construction of light railways, which are not numerous, was conceded by royal decree to private companies, but their working has been leased by the latter to main line companies, e.g., the Dutch

* "La Législation des Chemins de Fer Économiques" par M Colson,—*Bull de la Comm Internat du Cong des Chemins de Fer*, 1891

Railway Company, upon terms which differ considerably in one case and another These lines have been constructed almost universally without financial assistance from the State and always without a guarantee of interest The districts traversed have advanced in some instances as little as one tenth of the capital but the shares of the companies have often been subscribed by the Communes and the particular persons interested

These light railways are all laid to standard gauge but with a rail weighing not more than 51 6 to 60 5 lbs per yard (25 6 to 30 kilogrammes per metre) The open line is of course single The formation is narrower, the gradients and curves are sharper, and the station and signalling arrangements are simpler than on the normal railways Fencing is only required in exceptional places, such as station yards In 1894 there were* about 160 miles (258 kilometres) of light railways in Holland

They make junction with the main lines of railway, and can carry their 10 ton wagons without splitting the load The great railway ' ' ' tender

Local

Railway Company form the most important network They make up a total mileage of about 82 (131 88 kilometres) and cost, not including rolling stock about £3461 per mile The official report transmitted by our representative at The Hague, Mr Bland, gives the following information —

' The construction of this net which is 131 88 kilometres long, cost 3,013 080 florins (£251,000), or, including the advances made by the company working it up to the 31st December 1893 3 405 758 florins (£283 813), which is about 25 800 florins (£2150) per kilometre

' The cost of the rolling stock is not included in the above amount

' The company s capital (shares) amounts to 1,900,000 florins (£158 333) and was most of it supplied by the Communes and by private individuals in the district The advance, free of interest, of the Province of Overijssel amounted to 2715 florins (£226, 5s) per kilometre or to 67,194 florins (£5599) altogether, that of the Province of Gelderland 10 per cent of the cost of construction of the line Ruurlo Doetinchem, not exceeding 215,800 florins (£17,983)

and the manufactories in Eastern Overijssel These lines have al o a very perceptible influence on the industries in East Gelderland '

* I p rts fro i Her M jesty s Pepresentatives Abroad on L ght Pa 1894

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Railway Company, upon terms which differ considerably in one case and another These lines have been constructed almost universally without financial assistance from the State, and always without a guarantee of interest The districts traversed have advanced, in some instances as little as one tenth of the capital but the shares of the companies have often been subscribed by the Communes and the particular persons interested

These light railways are all laid to standard gauge, but with a rail weighing not more than 51 6 to 60 5 lbs per yard (25 6 to 30 kilogrammes per metre) The open line is, of course, single The formation is narrower, the gradients and curves are sharper, and the station and signalling arrangements are simpler than on the normal railways Fencing is only required in exceptional places, such as station yards In 1894 there were* about 160 miles (258 kilometres) of light railways in Holland

They make junction with the main lines of railway, and can carry their 10 ton wagons without splitting the load The great railway companies working the light lines employ upon them special tender locomotives, and special carriages for two classes of passengers

The light railways constructed by the Gelderland Overijssel Local Railway Company form the most important network They make up a total mileage of about 82 (131 88 kilometres), and cost, not including rolling stock, about £3461 per mile The official report transmitted by our representative at The Hague, Mr Bland, gives the following information —

"The construction of this net, which is 131 88 kilometres long, [illegible] ie advances made [illegible] 1893, 3,405,758 [illegible] £2150) per kilometre

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"The company's capital (shares) amounts to 1,900,000 florins (£158,333), and was most of it supplied by the Communes and by private individuals in the district The advance, free of interest, of the Province of Overijssel amounted to 2715 florins (£226, 5s) per kilometre, or to 67,194 florins (£5599) altogether, that of the Province of Gelderland 10 per cent of the cost of construction of the line Ruurlo Doetinchem, not exceeding 215,800 florins (£17,983)

. . . .

"A considerable quantity of merchandise, as well as a large number of passengers, are carried by the local railways

"A great quantity of coal is carried on the Gelderland Overijssel line, as well as raw and manufactured materials, between Rotterdam and the manufactories in Eastern Overijssel These lines have also a very perceptible influence on the industries in East Gelderland"

* *Reports from Her Majesty's Representatives Abroad on Light Railways*, 1894

The traffic on this network of light railways is a growing one, and in 1893 the receipts were —

For passengers, . .	88,145 florins	= £7345
For merchandise,	190,237 florins	= £15,853

Not only did the Provinces make advances, to the amount of about 10 per cent of the cost of construction, and the Communes interested also assist, either with subsidies or by taking shares, but the great railway companies treated the light lines most generously, and the relations which exist between them appear to be most satisfactory. The main line has undertaken extensions and enlargements at its own cost, under certain conditions If it works the light railway, the main line generally lets it use its stations and approaches free of charge, if the light railway is self working, a small charge per train mile, subject to a minimum, is made for the use of them, joint station working expenses are divided in proportion to traffic

The terms on which the Dutch Railway Company works eight contributive light railways, take the form either of a lease or of a partnership

In the first case, according to M de Backer's report* on "Contributive Traffic," the main line pays the light railway either a rent representing so much interest on the capital expenses, or the sum necessary to provide interest and sinking fund on the loan, or a percentage of the receipts after deducting the working expenses, which are on a fixed mileage basis In the second case, the two companies share the net profits in proportion to their share of the capital In both cases the working company is responsible for any deficit

As far as possible says M de Backer, and always on the lines worked by the Dutch railway, there are through passenger tickets Through consignment of goods, generally without transhipment, is also provided for The contract for hire of wagons stipulates that they be loaded within six hours, but their occupation between 8 p m and 6 a m is not paid for The main lines employ special tender locomotives, and carriages for two classes on the light railways

The Dutch light railways show how much can be done, less by direct pecuniary assistance, than by generous treatment and facilities tendered to such undertakings by the State and the great railway companies

The true light railways of Holland, however, in M Colson's opinion, are those laid on roads—"tramways"—which, beyond a restriction of speed to twelve miles (20 kilometres) an hour, enjoy otherwise the most absolute freedom Under the law of 1880, these tramways are brought under the same regulations as ordinary road traffic, as determined by the provincial authorities, with the single exception that the locomotives are subject to the usual rules affecting steam engines They require, therefore, no special concessions, but

* *Bull de la Comm Internat du Cong des Chem de Fer*, 1895

while they share the freedom of ordinary road traffic, they have to submit to the same tolls, which are very numerous on the Dutch roads These tolls are levied on each vehicle, and, as a natural conse

Province, the Com-
whoever may be the
proprietors of each road—have absolute power of permission or veto to use the road for tramway purposes The regulation of these tram ways varies with different local authorities, but the latter treat them as liberally as possible, knowing that they are beneficial to the country Instances of obstructions on the part of road owners are extremely rare

Some of the tramways are the property of the great railways, a few belong to the tramway companies of the large towns, but most of them were constructed by separate companies, of the last, a few are worked by the great railways or tramway companies, but most of the companies work their own lines

miles (783 kilometres), viz —

26	miles of	2 5½″	(0 75	metre) gauge
49		3 3⅜″	(1 00	)
258½	"	3 6	(1 067	")
153	"	4′ 8½″	(1 435	)

"The tramways of the private companies do not"—according to Mr Bland's report—"admit of direct junction with the main lines, even when their rails are the normal width apart The construction of the tramways does not permit the passing over of the luggage wagons of the railway companies, nor can the rolling stock of the tramway companies be taken on in the trains of the railway com panies

"The merchandise and luggage must be unloaded and reloaded at the junction

"Tender locomotives of 8½ to 13 tons are employed on the steam tramways. On a few lines locomotives are employed up to 16 tons

"The construction of the tramways under the second division* was assisted by the Provinces and Communes, in many cases in the form of payments, annually for a certain number of years Up to this time the State has given a subvention in one case only.

"The traffic on the tramways of this class, from the nature of the subject, varies very much On most of them the passenger traffic is the principal thing, and the conveyance of merchandise of small account

"This last is mostly confined to parcels, and is chiefly of local character

* *I e*, tramways proper, not town tramways.

"Milk, green vegetables, etc, are conveyed to adjacent dairy produce manufactories and towns, but, except in a few cases, this conveyance is inconsiderable, being restricted to small quantities in consequence of the numerous navigable canals

"Cattle are seldom conveyed, as they are generally driven to the railway stations and there put into the trucks. On many tramways, also, there is but little conveyance of wood, building materials, coal, and such like bulky goods On some lines in direct junction with the railways, and on others situated in industrial districts, or where the cultivation of beet root is carried on, a very considerable amount of merchandise, however is conveyed"

Sometimes a Commune will give a small annual subsidy for ten years to a tramway, in other cases a Commune will contribute a small lump sum towards construction, similar subsidies from the State or a Province are extremely rare, and in all cases private subscribers contribute the great bulk, or all, of the capital

As in Italy, so in Holland, light railways laid on public roads have been the most prominent development, and their comparative success is attributed by M Colson* to their being untrammelled by legislation, and fairly free to settle their own rates and arrange their own train service, so that the charges are as low and the revenue is as large as the application of ordinary business principles can make them

SWITZERLAND

More than twenty years ago there was a movement to introduce ... it died out There have been ... years, mostly in the direction ... tourists Their development seems to depend upon the encouragement given by the Cantonal Authorities to private companies applying for a concession

Thus, in the Canton of Geneva, concessions were granted by the Government to certain citizens for nine narrow gauge lines, radiating from Geneva An account of these was given by M A. Mallet in the Transactions of the *Société des Ingenieurs Civils* of France †

The area of the Canton is 93 square miles, its population is 107,000, of which the city of Geneva itself claims 70,000 Of ordinary railways there are 19 4 miles, of tramways 9 7 miles, and of these narrow gauge lines 43 3 miles The *Société Genevoise de Chemins de Fer à* ...

So far as the ...
laid on the side of ...
maintained by the Canton The track is not marked off from the rest of the road in any way, the streets of the city are narrow and

* *Bull de la Comm Internat du Cong des Chem de Fer*, 1891,—"La Legislation des Chemins de Fer Economiques"
† *The Railway World*, March 1895

crowded, the only warnings appear to be the sound of the driver's horn, and the notice "Look out for the train" painted in large letters on signboards at crossing and other special places, while the average speed is from six to nine miles an hour Yet accidents are few or none ... ard are ... , except ... system are adopted

There are as many as 22 six wheels coupled locomotives, workable from either end, roofed over and boxed in below to hide and protect the working parts Coke fuel is used in the city and briquettes out side Exhaust steam is not condensed but escapes noiselessly, and there is no trouble on this ground The engines weigh 13½ tons when empty, and 16¼ tons in full working order, the axle load is 5 4 ton The maximum speed is 16 miles. Fuel is expensive, about 25s per ton

... platforms, transverse seats, and a ... end, leaving seats for two on one ... y contain accommodation for 24 passengers inside, and—this is quite a continental feature—for 12 on the platforms The cars are heated by pipes through which the exhaust steam passes

The train crew (as many as three or four vehicles drawn by a locomotive may be seen in the streets of the city) consists of a driver and a stoker on the engine, and one or two conductors to sell and collect tickets on the train The stoker has to walk in front of the train, in going round sharp curves Return tickets only are sold at the termini, at shops, cafés, etc The fares are as much as 1¼d to 1½d per mile, except in certain cases where reductions are made The number of employés is not more than 3 per mile

These light railways cost (including £768 for rolling stock) £5760 per mile, but extensions have been made at a cost of only about £2000 per mile The receipts average £435 per mile per annum, the working expenses £340, about 77½ per cent of the receipts, and the net revenue £95, giving a return of nearly 2 per cent on capital

Only one instance can be quoted of assistance to light railways from the main lines The Jura Simplon Railway Company* took shares in the company formed to build the Trasellar Terannes line, and gave it junction facilities at Terannes

SWEDEN

Every year a certain amount of money is allotted by the Swedish Diet† for the purpose of making advances—not to exceed half of the

* "Contributive Traffic" by M de Backer, *Congress Bulletin of the International Railway Congress* 1895

† "Contributive Traffic," *Congress Bulletin of the International Railway Congress*, 1895

original construction capital—to companies formed to construct light railways The Government also grants free use of land and ballast quarries on State domains

The Swedish State Railways (who furnish this information) also permit the light railways to use their station junctions, either gratis or at a small rental The light lines build their own sidings, etc, and pay rent to the State Railways for any shunting and handling done for them by the latter State Railways' goods rates apply to the light lines, and there is a connecting service for goods between the main and feeder railways The Swedish State Railways* have no light railways of their own The latter all belong to private companies, are generally on the narrow gauge, are simply constructed and worked, and occupy their own land Many private railways have been constructed with 35 lb rails, and for a maximum speed of twelve miles an hour at a cost of only £2000 a mile †

So long ago as 1868 Mr C [illegible]
returns very much in favour [illegible]
The State railways were on [illegible]
66 lbs per yard, the Ko [illegible]
gauge, with a 34 lb rails The comparative figures ‡ are here quoted —

	Koping Uttersbergs	Government Railways
	£	£
Cost per mile,	1920	7300
Gross income per mile	216	513
Expenses per mile,	128	352
	per cent	per cent
Expenses per cent of gross income,	59 8	68 6
Net proceeds per cent of gross income,	40 2	31 4
" " cost of construction,	4 5	2 217

Of narrow gauge railways § there were, in 1891, about 1050 miles, varying in gauge from 1 $11\frac{5}{8}''$ to 4 0″ (0 6 to 1 217 metre)

* [illegible] *Congress Bulletin*

RUSSIA

Russia is such an enormous country that the development of her main line railways must for many years demand nearly the whole of her attention The great communications in Central Asia Siberia, and towards the Corea have been made mainly for military and political purpose. While the State has supplied a great deal of the capital required to build the railways and has full control over them, it has very little actual ownership* to show for it

Occupied as Russia has been, however with her principal lines of railway, a law† was passed in 1887 to establish feeder and light railways on a proper basis The law deals with *Chemins de fer de second ordre donnant accès aux voies magistrales* the latter being the main lines

All these minor lines, public or private, if worked by mechanical motors or connected with the main lines come under the control of the Minister of Ways of Communication Public lines on which animal traction is adopted are under the control of the Minister of the Interior All other lines of railway may be made without special

nt of the military authorities in

the road authorities where the

assistance afforded by the State is determined in each act of concession The maximum speed is fixed at 16 miles (26 675 kilometres) per hour, and the number of trains is prescribed Statistics of receipts expenses and working have to be furnished Companies projecting light lines are encouraged by guarantees of interest and special facilities The two Ministers immediately concerned with such lines invite their subordinates to

on the develop

o far but it is

the State

the main lines, are favourably disposed towards branch lines When they advance money for their construction the capital cost is charged to revenue by a suspense account spread over ten years The main line works the branches The tariffs on the branches are fixed in each case according to their length the value of the produce carried and in inverse proportion to the carriage effected on the main line, which is an indirect bonus

Bull de la Comm,

national Ra lway

CHAPTER VII

LIGHT RAILWAYS IN AMERICA AND THE COLONIES

Africa

UNITED STATES —In the United States the first roads were made and maintained by local authorities Later on, turnpike roads for through communication were built by companies not, as in England, by trusts During a brief period the construction of certain important trunk roads was held to be a matter of national concern to be paid for out of the national purse, but the value of these as routes of emigration and traffic to the north west and south west was greatly diminished by the development of the Erie Canal and its connections Cities sprang into existence upon its banks, and business and prosperity increased the more rapidly as the rates for transportation were reduced But already the railways—of which the Baltimore and Ohio is generally regarded as the pioneer—were pushing their way westward, and the contest between them and the great waterways—the Erie system and the Lakes in the north, the Mississippi river in the south—had com

American railways

The following statatics* for the year ending June 30 1896, will indicate the general results on American railways at the present time —

Railway capital	$10 566 865 771	Gross earnings	$1,150 169,376
Outlay per mile of		Total mileage	182 776
line			35 950
Capital stock			1 297 649
Preferred capital stock,			1 221,687
Total dividends †			
Passengers carried			
Freight tonnage	[illegible]	[illegible]	30 475

* *Herapath's Railway Journal* Oct. 29, 1897

† A fraction over 70 per cent of the capital stock paid dividends.

This difference in cost is mainly due to the difference in conditions. In England a special Act of Parliament has to be obtained. The case is dealt with by a Committee, first of one House and then of the other. Local bodies, private individuals, railway, gas, water, canal, tramway, harbour, and dock companies, who consider that their interests are threatened by the new scheme, oppose the application, and, in addition to the "House fees," thousands of pounds are spent by both sides in their endeavour to get the Bill either thrown out or passed. No doubt this is good business for the lawyers and engineers engaged, but it adds enormously to the cost of even the great railways, and has been absolutely fatal to the promotion of light lines.

The English railways have had to pay heavily for land and other property, and to buy out affected interests at great expense, while the Western and Southern railways in the United States were freely assisted with gifts of land which formed a rich endowment constantly growing in value.

Then most of the American railways were literally pioneers in a new country, clearing the way for the spread of immigration, the cultivation of virgin soil, the building of new towns, and the creation of new industries. All these things would, it was hoped, follow, but they did not exist along the line of route. In England the railways were extended along established routes of traffic, and carried on from one business centre to another. Capital was abundant, and the demand for substantial construction was at once complied with. In the United States,

what kind of a rail

have any at all

ments—the princip

a prime necessity in

The main object was to

permanent for temporary

the line up to the stand

were deferred until the line earned enough to pay for them. This was the only way in which the railways could be built. And, since economy in construction was the first consideration, the methods and

his section, so that his opportunity for saving in first cost began with the survey.

His permanent-way was limited

line as on the majority of English

quantity of permanent-way by abo

in earth work, ballast, bridging, etc.

* Railroad Transportation, p. 148.

footed or Vignoles rail, resting directly on the sleeper, instead of our bull headed and heavier rail, keyed up in a good solid chair and well bedded in ballast He could afford to be liberal with his wooden sleepers, but his iron, steel, and labour were much more expensive than ours

When the Sibi railway was being rapidly laid for military reasons on the Baluchistan frontier of India the road bed was prepared roughly by ploughing a width of 100 yards to loosen the earth for the packing gangs

In America the sleepers were simply laid directly on the ground without ballast To carry the railways across deep depressions, bold dips or cheap trestle work took the place of our flatly graded embankments or viaducts of brickwork or masonry The cost of trestles does not rapidly increase with their height, so that the economy of erecting them in a country where timber is cheap is an important one, but they are a likely source of accident, if such perishable structures are not carefully watched and maintained, and they are always exposed to the danger of fire In England a substitute of this kind would *never be permitted In India timber for the purpose is not generally* available, nor is it required because earth work is cheap

The use of wood as a cheap material is also applied to the construction of station buildings and offices and platform walls In India, wherever the climate is very dry, we generally find a cheaper substitute than wood in sun dried bricks set in mud, and covered with mud plaster, for station buildings, offices, and staff quarters, or we use grass screens for walls and thatch for roofs, while fuel platforms, and sometimes passenger and goods platforms, are faced with rail uprights and old sleepers and backed with earth In fact, Englishmen who make railways at higher cost in England, can make them still more cheaply in India than Americans do in America

But there are many onerous conditions imposed upon English railways—affecting not only their working but their construction—to which American railways were not subjected, and from which light railways must be relieved Some of these are demanded in the interests of public safety wherever the traffic is frequent, fast, and heavy, but their imposition on lines of slow and light traffic in country districts as well as in the busy main lines, has been a serious disadvantage and expense to the great systems, as well as an absolute bar to the development of light railways Without such restrictions, the Americans have been able to cross town and country roads on the *same level, instead of having to bridge the road or bridge the railway.* Indeed, the provision of signals and interlocking, or even of gatemen, at such level crossings, has been regarded as a luxury, and it would not be too much to say that they would have been an unjustifiable extravagance in the first instance The interlocking of points and signal, and the installation of block telegraph, are requirements not to be applied to pioneer lines in America, or to lines of poor traffic in India, but to be provided afterwards if the circumstances of the traffic demand them

However light a railway we desired to build in India the bridges would be constructed of brickwork masonry iron and steel save as a temporary measure but in the United States wooden bridges were an economical necessity

Of course, all this frequently involved the absolute reconstruction of the original line at a later period Money for the heavy expenditure on these so-called improvements was provided by the issue of bonds (with the gross misapplication of borrowed capital which ended in many cases we are not here concerned) It is also evident that economies of the kind above described in construction throw a heavier burden upon maintenance Thus, the Knoxville branch of the Louisville and Nashville system has been described by an American* as a fair sample of those western and southern railways which represent the true type of American practice —"They were cheaply constructed and have been, or are gradually being, perfected, mostly from the earnings, while being operated They are in the transition stage Many bridges, buildings, etc, of wood, have been, or are being, replaced with iron or other durable material, iron rails with steel rails, etc Until these changes are completed, the maintenance of way and operating expenses must necessarily appear large" How large they are, compared with those of a first-class American line, may be seen from the following figures for 1885 —

Details	Pennsylvania Railroad Division	Knoxville Branch
Length of line miles	1518	171
Cost per mile dollars	—	26 621
Average load of freight trains tons	210	126
" " passenger trains passengers	45	31
" " all trains, tons and passengers	167	91
[illegible]	Cent	Cent
[illegible]	0 080	0 243
[illegible]	0 037	0 045
[illegible]	0 133	0 210
Total operating expenses	0 410	0 819

The comparison is more convincing and instructive between two American lines than, as Mr Dorsey for the purposes of his own argument drew it, between an American cheap line and a first class English railway, the London and North Western, because, owing to the difference in traffic conditions in the two countries, figures based on ton mileage give a false view of English working

Other points of contrast present themselves—the universal adoption of the bogie principle in American rolling stock, the greater width (8 ft to our 7 ft 6 in) and height of their cars, through

* *English and American Railroads Compared*, by E. B Dorsey, C E.

passage from end to end of their trains by means of the central aisle as opposed to our compartment system, the division of service with sleeping car and express companies the latter doing for fast goods the work of collection and delivery which is done for higher class goods in England by the railway companies themselves, low speeds long leads full loads, and cheaper freight charges for low class goods in America instead of the quick transit short leads and prompt delivery which obtain in England the proportion of load to tare in the goods stock as high as 2 13 to 1 in America as low as 1 6 to 1 in England the perfection of our block system their luggage check system as compared with our successful lack of any system whatever in this respect etc * It is difficult to compare the rates, because so many of ours include collection and delivery, and their terminal expenses have a larger divisor to spread out their cost but Prof Hadley estimate roughly that making allowance for all disadvantages to which our railways are subject, our charges per ton mile on all traffic average from 50 to 75 per cent higher He regards 2 cents per mile as our normal passenger rate as compared with 2 35 cents in America Another American dealing with figures relating to the same year 1885 puts the average rate per passenger per mile in America at 2 198 cents, and in England about the same while per ton he makes a greater difference than Prof Hadley, viz 1 057 cents in America 2 to 2 4 cents in England.

But the main point is that construction in the two countries has been carried out on such totally different principles In the United States most of the western and southern lines have been practically, in the first instance light railways In England first class railways have been at once constructed and no departure from the standard has been tolerated Only now is it recognised that what America required as an undeveloped country and India as a poor country, [illegible] t to districts

[illegible] railway which [illegible] given a very

[illegible]

were so extremely favourable that the work of grubbing and clearing grading trestles, cross ties and ditching to make the road bed ready for the rails cost only $1005, or, including engineering and right of way, $11644 per mile Had the location been very unfavourable this portion of the construction might, as Mr Pew says have cost forty or fifty times as much Second hand rails of light section, 40 to 45 lbs per yard were available from the Central Railroad of

* The "luggage in advance" system is new

† *Trans Amer Soc of Civil Engineers* vol xxiii, 1890

Georgia, which had been relaid with a heavier rail, and thus the track was put down for no more than $1800 per mile Ultimately the way and works on the whole nineteen miles cost only $3441 per mile, ready for the rolling stock The business was of such a nature that most of the freight was received and shipped in foreign cars, so that $1000 per mile would have been sufficient to equip the line with all the rolling stock that was required, making the total cost $4441 per mile This additional capital expenditure, however, was happily avoided, as, by the terms of the agreement with the Wrightsville and Tennille Railroad—of which the new railway is an extension—the stock of the latter runs on both roads, and expenses are divided There were no middlemen to draw their profits out of the scheme, and swell the cost Mr A M Wellington in the course of discussion, claimed this cheap light railway built to broad gauge as a further proof of the small effect of gauge on cost

In 1887 the Dakota and Montana extension of the Manitoba railway laid with rails of light section cost £3000 a mile only

The United States may be said to have led the way in cheap railway construction They have also been the first to appreciate practically the advantages of electric traction, and this will be referred to later on

CANADA —The Toronto Grey, and Bruce Railway, and the Toronto and Nipissing Railway, were projected*—the former in a north westerly and the latter in a north-easterly direction—on either side of the 5 ft 6 in gauge Northern Railway of Canada, in order to open up back districts which could only be afforded railway facilities on the cheapest scale Accordingly a gauge of 3 ft 6 in was adopted The lines were fenced and fully ballasted, 12 inches of ballast being laid under the sleepers and the road well boxed up But the rails weighed only 40 lbs per yard, the station buildings, bridges, and culverts, cattle guards, etc, were of timber, and these lines cost $21 796 (£4541) and $18 390 (£3831) per mile respectively, as compared with $47 840 (£9967) the cost per mile of the broad gauge Northern Railway Further details of the locomotives rolling stock, and working of these Canadian narrow gauge railways are given but the information is not recent enough to quote

NEW ZEALAND —Cheap construction was as essential in New Zealand as in Canada The same gauge 3 ft 6 in, and the same section of rail, 40 lbs per yard, were adopted for narrow gauge lines Information concerning them is more recent † The cost, more than £8000 per mile,‡ is high, but the engineering difficulties must have been exceptional, the ruling gradients being 1 in 40 on the Auckland, 1 in 33 on the Napier, and 1 in 15 *against the heavier traffic* on the

Railways vol lxiii 1881 and ... 1883

‡ *Min Proc Inst C E*, vol lxxxvii, 1886 Pres. Address of Mr E Woods

Wellington section, with sharp curves on the two latter, and wages are as much as 6s 6d for labourers and 8s for gangers per day Fell engines, weighing 36 tons and designed to haul 53 tons up a

were hauled at a time one, two or three engines being used as required, and so placed as to avoid overstraining the drawbars, and 1½ hour was the time required for the double trip The cost of coal was 17s 6d per ton 110 73 lbs of coal were used per mile, and, although the wages of drivers ranged from 10s to 13s and those of firemen between 7s 6d and 9s per day the cost of locomotive power was not more than 4d per ton of net paying load per mile The original 40 lb iron rails are being renewed with 53 lb steel The railways are largely an investment in the future The Hurunui Bluff section has a considerable agricultural traffic, and its branches tap pastoral districts still to be developed The leads are short, because the line touches so many seaports, while the maintenance charges due to floods and large bridging are particularly heavy That the line is doing good service, there is no doubt whatever The extensions into new localities—mountainous pastoral wooded, or mineral—and still lacking labourers in the vineyard, may not add directly to the railway revenues for some years to come but in tapping productive though still unsettled areas of the colony they have made development possible Of the indirect benefit of these lines constructed as cheaply as possible in a difficult country, there is no question and, in view of their possibilities, a net revenue of 2 89 per cent on capital can scarcely be regarded as discouraging

AUSTRALIAN COLONIES —The direct results of railways in the Australian colonies are still more favourable, the net revenue being 3 75 per cent on capital invested in New South Wales 2 74 on capital cost in Victoria, and 3 [illegible]6 on capital cost in South Australia

Some recent statistics of three of the colonies are here quoted —

	New South Wales *	Victoria †	South Australia ‡
Miles open	[illegible]691‡	31[illegible]9	1 [illegible] 3 §
Capital cost per mile	£14 015	£1[illegible] [illegible]50	£ [illegible] 310
Earnings per average mile open	£1 133	£837	£595
Gross Revenue	£3 0[illegible]6 [illegible]48	£[illegible] 615 935	£1 0[illegible] [illegible]03[illegible]
Working Expenses	£1 614 605	£1 563 8[illegible]5	£614 [illegible]54
Net Revenue	£1 4[illegible] [illegible]43	£[illegible] 0[illegible] [illegible]130	£[illegible]10 [illegible]81
Train mileage	3 6[illegible]4 713	9 2[illegible]8 687	3 6[illegible]4 713
Gross Revenue per train mile	[illegible]s 3[illegible]	6s 8·03d	66 95d
Working Expenses per train mile	3s 1[illegible]d	3s 4 6[illegible]d	40 1[illegible]d
Net Revenue per train mile	3s. 4½d	2s. 3·36d	[illegible]6 83d

In South Australia* the introduction of the light railway principle dates back to 1867, when it was determined to extend the 5 ft 3 in gauge on a cheaper scale, costing no more than £5500 a mile, including stations and equipment, as well as to adopt the 3 ft 6 in gauge on other systems

The first extensions on the 5 ft 3 in gauge, very few additions to the rolling stock being needed, cost £5247 per mile The iron rails were as light as 40 lbs per yard spiked to wooden sleepers measuring 9 ft by 9 in by 4½ in and spaced 2 ft 9 in apart, centre to centre, with a sleeper under the joints, and 8 in of good limestone ballast underneath The stations were seven miles apart (about a mile less than the average distance between stations in India), and were provided with goods sheds 60 ft to 100 ft long the walls being built up of galvanised iron on wooden framework fitted into a stone substructure, with a galvanised iron roof on trusses of 45 ft span The stationmaster's house was of masonry, the booking office and waiting room of iron The line was enclosed by iron fencing The low sided wagons weighed 4 tons 4 cwts, and were designed for a load of 7 tons A 20 ton locomotive was intended to run at ten miles an hour

years For this the axle load and the speed, not the gauge, were responsible Other lines were made on the 5 ft 3 in gauge on the light-railway

Lines of 3

lb rails also,

rolling stock

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transverse se

wide, and carried 30 passengers The goods stock, with a length of 14 ft and width of 7 ft, consisted of low sided, medium, and covered wagons, weighing empty 2 tons 17 cwts, 3 tons 3 cwts, and 3 tons 10 cwts respectively, to carry loads of 6 tons each, and thus giving ratios of tare to load of 1 2 1, 1 1 9, and 1 1 7 The stations were placed as far apart as twenty miles, and included stationmaster's quarters, booking office, and goods sheds The water supply was a costly item—600,000 gallon concrete reservoirs every twenty miles, with high service tanks, steam pumps, etc

According to the Commissioners Report for 1893-94 the cost of the Southern group of South Australian lines on the 5 ft 3 in gauge had reached £9715 per mile, and that of the South Eastern group on

* *Min Proc Inst C E*, vol lvi, 1879 "Patterson on 'Railway Construction in South Australia'"

the lowest figures
in more
light railway
construction, one may be driven, in a country where the standard gauge is so wide as 5 ft 6 in or even 5 ft 3 in, to abandon it in favour of a metre or even a 3 ft 6 in gauge But, in a country which has been fortunate enough to adopt the more common and sufficient gauge of 4 ft 8½ in as the standard, the strongest reasons will be required for discarding it in favour of a 3 ft 6 in gauge, and the
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opinion being that such lines "could be constructed, exclusive of bridges, waterways, and station accommodation (which latter should be of the most simple nature), for £1750 per mile This could only
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reasonable
speed at a lower scale of charges than it is now carried by road The rates for such lines would bring about a material saving to the users, compared with what is paid for the carriage by road, and the scale of charge should be such as to avoid any material loss to the country Lines of this character would avoid the great disadvantage of break

types existing in the service, could pass over them, and thus avoid the great disadvantage and cost of creating a new class of rolling stock" The advice is sound Such pioneer railways have been
e proved
ordinary
15 to 20
has again

offers an
ts length
is ninety four miles, and it was completed in 1891–92 The total capital expenditure up to 1893–94 was £271,611, less than £2890 per mile The ground is so even that scarcely any work of the nature of

* *New South Wales Railway Commissioners' Report for* 1896 97.

† Ditto, 1897 98

‡ *Min Proc Inst C E*, vol cxxiii., 1895 "Steel Sleepers in Queensland," by J A Griffiths

grading was required A width of 66 ft was easily cleared of the dry and stunted vegetation and in the centre for a width of 10 ft, stumps and roots were grubbed out to a depth of 6 or 8 inches In the stiffer loamy soil the road bed was ploughed up for a width of 8 ft, while in the light sandy loam the surface was merely loosened by scarifying The formation was then made even by a 3 ton roller Material was landed at the Normanton wharf, trained up to the extreme end of the laid rails, unloaded and stacked Four men loaded the material upon the trolleys, and three of these and one horse were engaged in conveying the material from the stacks to rail head an average lead of 20 to 25 chains The fastenings were separately carried ahead in boxes Each trolley was drawn to the end of the last pair of rails laid until its load was used up, when it was lifted off to make room for the next loaded trolley, and again replaced to be hauled back Behind the working trolley eight men completed the fastenings Lifting ramming and straightening occupied twenty five men The permanent way consisted of $41\frac{1}{4}$ lb steel flat-footed rails on wooden or steel sleepers The latter, where laid on the second section weighed 100 lbs and were made by Messrs MacLellan of Glasgow In section they were trough shaped, the sides $\frac{3}{16}$ in thick the top $\frac{3}{8}$ in thick the ends open, and the rails resting directly on the sleepers were held by clips and bolts Their cost was —

Messrs MacLellan's contract	90l	120 0s 0d
Freight lighterage and charges	30 0s 0d	

Mr Griffiths, however, thought that steel sleepers of this pattern might, under
port at 78d
coating 18d,
Mr Griffiths states that a team of twelve to fourteen bullocks, a horse, and fifty to seventy men and boys were employed, the average cost in the earlier stages was over £71 and towards the end less than £59 per mile The labour charges on the shorter portion of the line laid with wooden sleepers were nearly 50 per cent more Of the estimated cost £2162 per mile was for materials, labour surveys plans and supervision and about £600 per mile for station accommodation rolling stock, surplus material, and land resumption Ballast had to be used in the slight depressions where drainage collected and the steel sleepers cut in too deeply, but the idea appears to be to let them bed themselves in compressed soil In flood time the road gives some trouble, but the ordinary maintenance staff consists of only thirty four labourers, one inspector of permanent-way, and one officer in charge of traffic and maintenance The work was carried out by daily labour at the cost of the Queensland Railway Commissioners, their paymaster paying monthly wages on the certificate of the superintending engineer

With reference to the falling off in traffic receipts it is noted that

the rates for all classes of traffic were reduced to about two thirds of their previous amount to assimilate them to the southern traffic This diminished the net revenue by nearly half, and apparently added little to the amount of business done It seems to enforce the occasional necessity of allowing light railways to charge higher rates to keep themselves alive

The following figures may be quoted —

Season (Year)	1892 93	1893 94
Traffic mileage	94	94
Total capital expenditure	£2 0 368	£271 611
Traffic receipts	£20 230	£14 757
Working expenses	£12 401	£10 301
Earnings per train mile	118½d	101¼d
Percentage of net earnings on capital	2 896	1 641
Rainfall	Light	Very heavy
Maintenance per mile	£76 93	£61 73
Labourers per mile	0 45	0 36

Seven extensions covering 192 miles of the State railway system of Victoria* into the Mallee district illustrate the economy of the "butty gang system No large contracts are let, but the work is given out to butty gangs of any number of men up to sixty at rates which would enable the average man to earn the standard wages in an eight hours day The district is too sparsely populated to prom se much passenger and ordinary goods traffic, but lines were wanted to carry agricultural produce chiefly wheat to the seaport at low rates By only carrying out works indispensable in the first instance, deferring others until the traffic of the district required and could pay for them, and building on the butty gang system, the price has been kept within £2000 a mile, upon which moderate earnings will yield a profit By special rollers and ploughs the scrub and stumps have been cleared and wheat cultivation of extensive areas has been a great success The surface is generally level or slightly undulating, with occasional sand hills, an absorbent subsoil and blind water courses The railway extensions have been made on the 5 ft 3 in gauge, with 60 lb steel flat-footed rails capable of carrying all ordinary rolling stock except the heavier engines The sleepers are of eucalyptus, tough, heavy, and enduring Where gravel ballast was too costly, sand has been used on a total length of eighty miles The excavation for earth work was from 3400 to 6200 cubic yards per

crossings cattle pits are used The stations are six miles apart, with six inch platforms, the corridor carriages having steps at the end, but in cuttings the platforms are made up nearly to floor level, which

* *Min Pro Inst C E* vol cxxix, 1897 —' Economic Railway Construction in Victoria,' by M. E. Karnot

is convenient in handling goods The engines are six wheels coupled, with 12 tons load on the driving axle, and tenders weighing 24 tons, including 2200 gallons of water They haul as much as 900 tons. Labourers' wages were 5s to 6s per day of eight hours The average cost per mile of these extensions, built between 1893 and 1895, was as follows —

	£11
	37
	15
	173
Bridges	31
Culverts	21
Gravelling roads and approaches	17
Ballast (sand and gravel)	1 5
Sleepers	3 6
Rails 60 lb steel fastenings freight and laying	659
Temporary station buildings (including platforms)	20
Water supply (temporary)	8
Signals	3
Telegraph	13
Engineering and surveying	167
Miscellaneous items	4
Interest on capital during construction	33
Total cost per mile to date of handing over	£1768
Approximate expenditure since opening	92
Total cost per mile to 30th June 1895	£1860

The results prove the economy (as we have long since found in India) of doing without the big contractor

ft 3 in
3 in in
It is
Wales
to fall

back on wherever reduction of gauge is a *sine quâ non* The question of unification of gauge will come still more prominently to the front if and when the Federation of the Australian Colonies—now being definitely discussed—becomes an accomplished fact

The cost—if the conversion be complete—will be enormous The alteration of 1375 miles of 3 ft 6 in line in Queensland alone would cost 5½ millions sterling,* while the goods tonnage is only about 4,000 000 A saving on transhipment of the whole goods traffic, of 1s a ton, therefore would only pay about 3½ per cent on that amount The conversion of existing rolling stock would be a formidable undertaking The laying of a third rail, and cost and complication of mixed gauge are undesirable The unification of gauge on the most important inter colonial routes, and the recognition in future of 4 ft 8½ in as the standard gauge, would, however, be more immediately practicable

* *Min Proc Inst C E*, vol cxxxi p 469

There are no navigable rivers to speak of in Australia, either to take the place of the railways that are lacking or to compete with those that are made There is a continual demand for new lines to develop the resources of the interior and bring the inland settler into communication with the seaboard These must be cheaply constructed, and direct and remunerative returns may not always be expected The results so far are creditable to the policy of encouragement which has been pursued This is exhibited in the grant of Crown lands and the offer of contracts on favourable terms The company undertaking the construction of the line may retain the property for a certain period after which the railway would become the property of the Crown or the railway after it is constructed may at once become the property of the Crown or the right of purchase by the Crown at a future time may be reserved The grant of Crown lands is by way of payment or subsidy to the constructing company, and the actual value, without any reference to future betterment may, in the first case be equal to twice the cost of construction in the second or third case equal to the cost of construction In addition to these grants of land by way of subsidy for construction land for the actual occupation of the railway its stations offices etc would be a free grant from the Crown Such terms as these have been offered by the Queensland Government

SOUTH AFRICA—Ten years ago the cost per mile of the Cape Government railways averaged £8872 on 1599 miles of line open Last year 1894 miles had been constructed at a cost of £10 165 per mile and the following figures may be quoted from the *Statistical Register of the Cape of Good Hope for the Year* 1897, 'Interchange —Government Railway System —

	18[illegible]3	1887	1897
Miles of line open	63¾	1599	1894
Number of passengers conveyed	436,51[illegible]	[illegible]	[illegible]
Tonnage (Cape ton 2000 lbs) of goods	60 3 8	36[illegible] 043	1 340 414
Train miles run	13 1 6	[illegible]	[illegible]
Earnings	£05 69	£1 [illegible]1 1[illegible]4	£3 0[illegible] 897
Working expenses	£1 67	£6 1 837	£1 [illegible],316
Capital invested on lines open	£[illegible]3 [illegible]4[illegible]	£14 1 6 45	£18 9[illegible] 5[illegible]
Net receipts per cent of capital	£[illegible] 1s. 6d	£4 3s. 11	£6 [illegible]s 6d
Capital expended to 31st December	£[illegible] 3 843	£14 1[illegible] 45	£1[illegible] [illegible] 3 15[illegible]
Cost per mile to 31st December	£13 654	£8 8 2	£10 165
Working rolling stock—			
Locomotives	1[illegible]	[illegible]7	4[illegible]
Carriages	3	304	5
Trucks	115	3[illegible]3	[illegible]
Other kinds of vehicles,	9	319	3[illegible]4
Earnings per train mile	9s 8 64d.	8s. 10 5d	6s. 11 11
Expenses	6s 3 [illegible]1	4s. 9 1d.	4s. 3 31
Expenses per cent. of earnings,	6[illegible]09	53 6	61.8

The gauge of the Cape Government railways is 3 ft 6 in, the lines are well and substantially laid and the trains run at fair speed and are comfortably equipped The Western system extends from Cape Town to De Aar (501 miles) and branch lines are being constructed to tap agricultural districts The Northern system starts from De

Aar, passes through Vryburg and Mafeking, and reaches Bulawayo (839 miles) The Cape Government have entered into an agreement with Mr Cecil Rhodes to work the Bechuanaland Railway Company's line from Vryburg to Bulawayo The Midland system extends from Port Elizabeth to De Aar (339) the trunk line being continued from Naauwpoort Junction into the Orange Free State and the South African Republic From East London the Eastern system runs to Aliwal North (282 miles), and to Springfontein (315 miles) in the Orange Free State

There are also 359 miles of private railways—of which one (Port Nolloth and O okiep—Cape Copper Company) is on the 2 ft 6 in gauge, and the remaining five on the 3 ft 6 in gauge—but their cost is not given

Passenger fares are at the rate of 3d, 2d, and 1d per mile for first, second, and third class respectively, return fares costing only 50 per cent more than the single fare. The rates for South African produce is 1 1 per mile, with terminals, and for imported produce (wheat, mealies, etc) is 1d per mile, plus terminals Import cargo of all descriptions is conveyed at very low rates Groceries beer, spirits, carbon for electric lighting, mining machinery, etc, are conveyed from Cape Town to Kimberley for 11s 1d and to Bulawayo for 18s 8d. per 100 lb, while cement printing material horses cattle, etc, are charged 5s per 100 lbs to Kimberley, and 13s 1d to Bulawayo Over-sea traffic for the gold fields from Cape Town to Johannesburg (South African Republic) is carried at lower rates From Port Elizabeth and East London rates on a similar scale are applied to over sea traffic for Kimberley, Bulawayo and Johannesburg

The mileage added to the Cape Government railways during the last ten years is singularly small, considering the increase of railway business during the same period and the increased cost per mile would seem to indicate that too high a standard of construction has been adopted If fertile and mining districts are to be opened up, cheap lines should be rapidly constructed on light railway principles

We have the Egyptian railways, the Soudan railways the Uganda railway, and the South African railways still to be linked up, and, as far as possible, on light railway principles The Uganda railway is on the metre gauge, but could be easily adapted to that of all the others—the 3 ft 6 in The gaps must be filled on the same gauge, for through lines from north to south

CHAPTER VIII

LIGHT RAILWAYS IN INDIA

CONTENTS —Railways at first constructed by guaranteed companies—State

light railways arrested by uncertainty of exchange.

State Railways—Proposals for the construction of railways in India* were made as long ago as 1844 In 1849 agreements were signed between the Secretary of State for India and the East Indian and Great Indian Peninsula Railway Companies, under which the companies received a free grant of land for railway purposes and a

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troubles of the Mutiny of 1857, but by the end of 1859 about 5000 miles of line were in course of construction, by eight guaranteed companies In 1869 the State Railways system was initiated On the 31st March 1897 no less than 20 390 miles of railway were open for traffic of which 11,736 miles were on the standard or 5 ft 6 in gauge, 8366 on the metre gauge, and 288 miles on the 2 ft 6 in and 2 ft or special gauges as shown on page 118

The Court of Directors were at first inclined to adopt 4 ft 8½ in as the gauge on the East Indian and Great Indian Peninsula Railways This was the proposal of the companies at home and, had it been adopted, the gauge difficulty would have been settled for ever so far as India is co
would have been
with locomotive
would be easy,

was advised by Mr Simms (who
is consulting engineer in 1845) to
nds that it would not only secure
greater advantages than the 4 ft 8½ in, but would substantially com

* *Railway Policy in India*, by Horace Bell M Inst.C E.

mand those possessed by the 7 ft gauge In ultimately deciding to adopt 5 ft. 6 in as the standard gauge, the Court of Directors committed themselves to an equally unfortunate and singular compromise

The total capital outlay on Indian Railways up to the end of 1896 was Rs 2,73,07,27,181

TOTAL LENGTH of INDIAN RAILWAYS, open for Traffic on the 31st March 1897

		Standard or 5 6 gauge	Metre gauge	2 6 and 2 0" gauges	Total
State lines worked by companies.	Miles	3 740	6 543		10 283
State lines worked by the State		4 468	599	28	5,095
Lines worked by guaranteed companies,	,,	2,588			2 588
Assisted companies,	,,	183	173	72	428
Lines owned by native States and worked by companies	,,	633	188	72	893
Lines owned by native States and worked by State Rail way agency,	,,	124		22	146
Lines owned and worked by native States	,,		804	94	898
Foreign lines, .			59		59
Total to the end of March 1897,	,,	*14 736*	*8 366*	*288*	*20 390*

The average cost per mile of railway open was as follows —

Standard gauge,	Rs 158,973
Metre gauge,	,, 71,125
Special gauges,	,, 33,514

but reasons have been given in chapter xii for regarding Rs 120,000, Rs 75,000, and Rs 30,000 as roughly the cost of representative modern lines on each gauge

The following figures apply to the calendar year 1896 —

Coaching earnings,	Rs 9,20 22,892
Goods earnings,	Rs 15,41,51,505
Miscellaneous, including steamboat,	Rs 74,86,028
Gross earnings,	Rs 25,36,60,425
Working expenses,	Rs 12,19,76,875
Net earnings, . .	Rs 13,16,83,550
Passenger mileage,	6,427,608,140
Goods ton mileage,	4,588,716,024
Number of passengers,	160,817,267
Tonnage of goods, etc , carried, .	32,471,335

The percentage of expenses on gross earnings in 1896 averaged 48 09 on all lines, 47 17 on the standard, 50 56 on the metre, and 54 80 on the special gauge lines

The statistical return on capital expenditure on open lines gives the following percentages —

Standard gauge	Metre gauge	Special gauges.	Total
5 17	5 27	7 76	5 20

Unfortunately, the State, although it could now raise money at 2½ per cent, has to pay interest to the guaranteed railways at 4¾, and to remit earnings in sterling with a rupee worth about 1s 3d under contracts which were made at a time when the rupee was worth 1s 10d The loss on this difference in rupee value alone amounted in 1895 96 to more than 100 lakhs, and the total loss on all charges appears as Rs 1 62,02 680

What the "Railway and Canal Traffic Act" of 1888 is to English railways, the "Indian Railway Act" of 1890 is to Indian railways, and the provisions of the latter in the chapter dealing with Railway Commissions and Traffic Facilities follow very nearly the same lines as

reasonable terminals charges in respect of stations, sidings, wharves, depots warehouses, cranes, and other similar matters, and of any services rendered thereat Again, the Act places upon the railway the burden of disproving a charge of undue preference in respect of rates and services as between one trader and another The decision in such a case is placed in the hands of a Railway Commission, consisting of one Law Commissioner and two Lay Commissioners, but this is not as in England a Standing Commission but one formed by the Governor General in Council at any time that he may require

The following are the maximum and minimum fares and rates for coaching and goods traffic laid down in the Government of India Resolution No 563 R T, dated the 16th of July 1891, as modified by the Government of India Circular No 11 Ry, dated the 4th of December 1896

Passenger Fares	Maximum per mile	Minimum per mile
1st Class,	18 pies (1½d)	12 pies (1d)
2nd Class	9 pies (¾d)	6 pies (½d)
Intermediate,	4½ pies (⅜d)	3 pies (¼d)
3rd Class,	3 pies (¼d)	1½ pies (⅛d)

Goods Rates	Maximum per mile		Minimum per mile	
	Pies per maund	Pence per ton	Pies per maund	Pence per ton
5th Class,	1	2¼d		
4th Class	⅞	2d		
3rd Class,	⅔	1½d	⅙	⅜d
2nd Class	½	1⅛d		
1st Class,	⅓	¾d		
Special,	¼	½d	$\frac{1}{10}$	¼d
Explosives,	1½	3⅜d	⅙	⅜d

For the purpose of expressing these approximately in English terms, the rupee has been assumed to be worth 1s 4d and 27 22 maunds to be equal to 1 ton

For example, on the North Western Railway, the fares * per mile are as follows —

	Generally	Mushkaf Bolan and Sind Pishin Lines
1st Class,	12 pies (1d)	18 pies (1½d)
2nd Class,	6 pies (½d)	9 pies (¾d)
Intermediate Class	3 pies (¼d)	4½ pies (⅜d)
3rd Class,	2¼ pies ($\frac{3}{16}$d)	3 pies (¼d)

and the rates† per ton per mile are as follows —

Special class goods,	9 07 pies	(0 76d)
1st ,, ,,	9 07	(0 76d)
2nd ,, ,,	13 61 ,,	(1 13d)
3rd ,, ,,	18 15 ,,	(1 51d)
4th ,, ,,	22 68 ,,	(1 89d)
5th ,, ,,	27 22	(2 27d)

The application of minimum rates and fares was considered necessary to prevent the possibility of a guaranteed railway working at rates so low that they might cause a loss to the Government from which the shareholders were protected by the Government guarantee

English readers will perhaps be interested to know the rates between Delhi and the seaports for grain and seeds for export and for piece goods imported The present railway distance of Delhi from Calcutta is 954 miles, from Bombay 888 miles, and from Karachi 943 miles, but when the Kotri Bridge is finished the distance of Karachi from

* Appendix VI, *Coaching Tariff, N W P, India*, para. 24

† Appendix VI, *Goods Tariff, N W P, India* para 26

Delhi will be only 906 miles The piece goods rate from these parts to Delhi is Rs 2 6 3 per maund From Delhi the rate for grain and seeds is 8 annas 6 pies to Calcutta and 10 annas 9 pies to Bombay or Karachi

The Table on p 123 shows the passenger fares and goods rates which obtain on a few representative Indian railways, and it will be noticed that they are highest on the Jodhpore Bickaneer (metre gauge) and Cooch Behar (2 ft 6 in gauge) railways, which may be regarded as light lines

Light Railways —The question of light railways on the narrow gauge arose as far back, at anyrate, as 1862, when Mr J L Wilson (Agent for the Indian Branch Railway Company) informed the Government of India that he was "prepared to enter into definite arrangements for the construction of the roadways and the laying down of light railways thereon in Oudh and Rohilkund In reply, the Government of India, while insisting upon the adoption of the 5 ft 6 in gauge for all railways intended to form portions of main lines, would sanction as a temporary expedient the construction of narrow gauge light lines where the probable traffic was not sufficient to warrant a larger outlay, but only with the view of bringing them up to the standard in gauge and quality, when the traffic had so far developed as to require it

The Indian Branch Railway Company deserves particular mention, because, as Mr Horace Bell observes,* "of all the numerous companies that were projected for building light railways in India, this was the only one in Northern India that actually did proceed to build lines" This Company laid a light railway of 4 ft gauge on the public road from Azimganj to Nalhati in Bengal, but the line, after being bought by the Government of India, was relaid on the 5 ft 6 in gauge

Lord Canning was very much in favour of Mr Wilson's proposals for laying light ... as feeders to the standard gauge ... insisted that the proposed light li... 5 ft 6 in gauge, and Mr Wilson was not unready to accept this decision

Sir C Trevelyan's protest (in a Minute, dated 4th September 1863) against the construction of any railways, light or otherwise, on any but the 5 ft 6 in gauge, is so interesting, not merely in regard to India, but in connection with the question of light railways in England, that one paragraph deserves quotation —

"I have always been of opinion that a fallacy is involved in the idea of light railways The railway experience in England is greater than that of any other country For many years after our railway

* *Railway Policy in India*, by Horace Bell, M Inst C.E., p. 125

PASSENGER FARES AND GOODS RATES

Railway	Passenger Fares in Pies per Mile				Goods Rates in Pies per Ton per Mile						
	1st Class	2nd Class	Intermediate	Lowest.	Food Grains	Coal	1st Class.	2nd Class	3rd Class	4th Class.	5th Class
Standard Gauge—											
East Indian,	18 00	9 00	3 50	2 50	3 27 to 9 07	2 72 to 9 07	9 07	13 61	18 15	22 68	27 22
North Western	12 00	6 00	3 00	2 25	2 72 to 6 81	2 72 to 9 07	9 07	13 61	18 15	22 68	27·22
Madras,	12 00	6 00		2 00 to 2 50	4 01 to 10 00	3 00 to 10 00	10 00	13 61	18 00	21 00	30 00
Metre Gauge—											
Rajputana Malwa	15 00	8 00	3 00	2 00 to 2 25	2 72 to 9 53	2 72 to 4 08	9 53	14 29	19 05	23 14	27 22
Jodhpore Bickaneer,	18 00	6 00		2 00	8 17 to 10 89	10 89	13 61	20 41	25 86	31 30	36 75
2' 6" *Gauge—*											
Cooch Behar,	21 00	12 00	6 00	4 00	←			27 22			→

N.B.—Roughly 12 pies = 1 penny.

specious the light railway principle might be, there was something in it which always led to its being abandoned on close examination, and it never arrived even at the dignity of an experiment. Cheap agricultural railways are now being made in various parts of the country, but they are all solid, full gauged railways quite capable of bearing the rolling stock of the main lines with which they are connected and their cheapness arises only from their being single lines, from the landed proprietors asking moderate rates for their land, because they are convinced of the advantage to them of the railways, and from the Parliamentary expenses having been reduced to a mere trifle

The general adoption of Lord Elgin's views, and the desire of the Government of India to adhere to the standard gauge so far as possible are indicated in the following extracts from a dispatch,* dated April 1864, from Sir John Lawrence, Governor General, to the Secretary of State, with reference to the negotiations between the Government of India and the Indian Branch Railway Company —

tion of light railways of the intended that the engines of It was well understood that in England engines of one company are rarely run on the line of another, and that the practical working of railways is not compatible with such a system of interchange of engines, and that all that is ever requisite is the interchange of waggons and carriages A 5 ft 6 in gauge light line was accordingly considered to mean a railway speed the ordinary passenger and main lines Elgin authorised an arrangement which the character of the Oudh *defined, by declaring that the* maximum load per wheel should be 3½ tons, and the maximum speed 15 miles an hour This will allow of the ordinary waggon and ning over the Oudh To these arrange

"29 It only remains to us to call attention to two minutes of Sir Charles Trevelyan, in the arguments of which we have been unable to concur

"30 In his first minute, dated 30th September last, objection is *taken to the construction of narrow and light railways* So far as the present proposals are concerned, the question of narrow lines does not arise But we are not prepared to recede from the position before taken up by the Government of India in respect of such lines, viz That when nothing better can be got, and with due provision for their resumption and conversion into full gauge lines when the traffic calls for the change, the Government may, without objection, aid

* *Railway Policy in India*, by Horace Bell M Inst C E.

such lines, in each case determining the amount of aid with reference to the objects to be attained

"31 As regards light lines, very nearly the same remarks will also apply. As soon as the Government gives up the system of guarantee, and abandons all right or desire to interfere in the management of railway companies' affairs, it ceases to be in a position to decide whether a line shall be constructed of rails of one class or another Such a matter is essentially one for the company to determine What the Government can do is to decline giving assistance, unless certain terms are offered by the companies, or the companies can refuse to accept the assistance offered if it be too little to satisfy them The Government of India has adopted the conclusion that a 5 ft 6 in gauge line, of such a character as will admit of the carriage and waggon stock of the great lines going over it at a moderate speed, will probably be, for many years to come, sufficient to meet the [illegible] rail standard it has taken [illegible]

[illegible] Railway—which included [illegible] absorbed the Indian French Railway Company of that time—was constructed on the standard 5 ft 6 in gauge

The Indian Tramway Company meanwhile was putting forward proposals for narrow gauge light lines in Southern India, and constructed a railway on the 3 ft 6 in gauge between Arconum and Conjeveram in 1865, which after being made part of the South Ind[illegible] converted to metre gauge in 1875 [illegible]

[illegible] it [illegible] ro [illegible] of

of iron, 36 lbs and 40 lbs to the yard, laid on [illegible] deodar and creosoted pine As first conceived, it was a light railway directed from Delhi to the Sambhar Lake and salt works The rail weighed 36 lbs per yard, the width of formation was 12 feet, and the maximum axle load was 4 tons for waggons and 6 tons for engines, while the speed, limited to 15 miles an hour, scarcely exceeded 10 All that the Government of India claimed then was "the sufficiency of a narrow gauge to carry our secondary lines" But when the Rajputana Railway was extended to Ahmedabad, where it made connection with the standard gauge Bombay, Baroda, and Central India Railway, it occupied the longer portion of the direct route from Delhi to Bombay The quality of the line had, from the beginning, been first class, and when it became necessary to adopt a 50 lb steel rail as the standard, 14 ft and 16 ft as the [illegible] tons for wagons and [illegible] an hour, its claim to [illegible] word had vanished [illegible] to the Sambhar Lake [illegible] The extension to [illegible] 1879

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In 1870 the whole question of gauge for light railways was the subject of keen debate in England, and the state of the case in India was described by Mr W T Thornton in a paper read before the Institution of Civil Engineers on the 4th February 1873 The recommendation by Col Strachey, Col Dickens, and Mr Rendel to regard 2 ft 9 in as the alternative to the standard gauge is justified to day by the increasing development of 2 ft 6 in gauge lines, and had their advice been followed, the continuity of standard gauge on main routes would have been assured

Lord Northbrook wished to lay the Indus Valley and Punjab Northern Railways with light 60 lb rails on the 5 ft 6 in gauge The Duke of Argyle who was then Secretary of State was strongly in favour of the metre gauge being adopted as being both adequate and suitable but

rail were prescribe

Duke of Argyle a

Northbrook in regard to both rail and gauge Accordingly the Indus Valley Railway was constructed on the standard gauge, while so much of the Punjab Northern as had been laid between Lahore and Jhelum on the metre gauge was converted to standard and the extension to Peshawar was carried out on the same scale The works on the Grand Trunk road between Lahore and Wazirabad were also abandoned and the railway placed on an independent alignment

In 1880 Lord Lytton suggested that the Provincial Governments

cussed between the Punjab Government and the Sind, Punjab and Delhi Railway This line was taken over from the company by the State on the 1st of January 1886, and thenceforward became part of the North Western State Railway, under the management of Col Conway Gordon, R E, who at once addressed the Punjab Government with reference to this important question of the construction of light railways in the Punjab

Anticipating that on so large a system as that under his management the annual renewals of rails might average about 100 miles Col Conway Gordon proposed to utilise these second hand rails for the purposes of light railways Although second hand rails which were unfit for the main line would be equally useless for branch lines, if the latter were constructed as first class railways, they would serve excellently for light railways or tramways, and he considered that light railways or tramways only were necessary for opening up the country in the first instance Wherever, therefore, the Punjab Government were of opinion that a branch line would be useful for opening up a district or for connecting any important town with the North Western Railway system, a cheap surface tramway should, he suggested, be laid down without platforms, stations, or any other expensive conveniences, the object being, in the first instance, to get

the metals linked through and the traffic started with a minimum of expenditure In short, the branch should be regarded simply as a tram, not a railway, and designed for a speed of not more than ten miles an hour He proposed that the North Western Railway should give old rails, sleepers, etc, and that the Punjab Government should give the land and furnish the small cash expenditure necessary to lay down the line The North Western Railway should work the line as cheaply as possible, debiting the revenue account with actual expenditure only, and the net earnings should be paid over to the Punjab Government until their expenditure, without interest, had been recouped After that the branch should be considered a part of the North Western Railway, and the net earnings devoted to the improvement of the line until it reached the general standard of other North Western branches Col Conway Gordon hoped that the expenditure thus required of the Provincial Government would not be more than Rs 2000 or Rs 3000 a mile to lay down such lines and open them for traffic

The Government of India in 1887, when Col Conway Gordon had become Director General of Railways, reverted to these proposals and observed that, as a first experiment, two important towns should be selected, connected by a road wide enough to admit of the tramway being laid on the side of the road The 2 feet steam tramway at Ferozpore was quoted as a successful example of a line on this plan It will be noticed that in 1886 Col Conway Gordon appeared to be in

sposed

vision,
N W R) was asked to submit a rough estimate of the cost of laying a light railway from Montgomery (on the North Western Railway) to Pakpattan After riding over the proposed route, the writer estimated that such a line could be made for Rs 480 483 or (the length being 28 miles) Rs 17,160 per mile Nothing was put down for preliminary expenses, as so short and easy a line could be laid out by the Multan divisional staff and the land, which was mostly waste, would be given by the Punjab Government but the value of the second hand permanent way material was included thus —

	Rs
39 60,000 c ft earthwork	15,840
Bridges and culverts—	
	17,000
oot run),	63,360
	284,730
	5,000
Supervisional charges, etc at Rs 24½ per cent,	94,553
	Rs 480,483

The prospects of this line were not so favourable as to induce the Punjab Government to undertake its promotion

In 1891, at the request of Col Wallace, R E, director of the North Western Railway, the writer submitted a note on "Feeder Lines in the Punjab and the New North Western Route between Delhi and Karachi" Attention was drawn to the rapid development of canals in the Punjab by the Irrigation Department without any corresponding development of feeder railways to tap the districts opened up to wheat cultivation and gradually being colonised It was pointed out that with second hand material from the main line, such light railways could be and that from Wazirabad was being, constructed at a cost of Rs 18 000 to Rs 20 000 a mile The profits contributed by branch to main lines generally were discussed, and the direct and indirect benefits likely to accrue to the province of the Punjab the North Western Railway, and the canals from the construction of certain minor branches and connections on the light railway principle were described At the same time particular notice was taken of the possibility of some of these lines being effective, in the first instance, as local railways and feeders only, but, ultimately, as forming part of direct main routes The three projects particularly alluded to were the Chord line from Wazirabad to Multan, that from Rohri to Kotri and that from Bahawalpur to Delhi The two latter have just been completed as first class railways, the Rohri Kotri line by the State and the Southern Punjab line by a company The North Western route from Delhi to Karachi by these two Chords is thus reduced to 906 miles, as against 888 miles by the I B and C I route from Delhi to Bombay, and 954 by the East Indian to Calcutta The line from Wazirabad to Khanewal is under construction in accordance with light railway principles, as indicated by Col Conway Gordon, but the actual cost of construction is nothing like so low as he estimated

The object of this line is to open up the country now watered by the Chenab Canal Settlers from other parts are reclaiming the desert land as it becomes fertilised by the supply of canal water, and the railway will provide the means for exporting grain and other produce The branch was completed as far as Lyallpur in February 1896, the permanent way consisting of second hand rails and sleepers obtained from the renewals of the main line In the first instance, only one fifth of the full section of ballast has been spread Girders for all bridges have been furnished from the old stock of the North *Western Railway The extension to Khanewal will be practically a* surface line with maximum grades as flat as 1 in 400 The actual cost of the Wazirabad Lyallpur section, including rolling stock, was Rs.38,78 000 for 95 68 miles The sanctioned estimate for the extension from Lyallpur to Khanewal amounts to Rs 27,00,000 for 105 miles, without rolling stock

In 1889, Colonel Conway Gordon, as Director General of Railways, attempted once more to have precise and definite rules laid down on

the question of gauge The Secretary of State, however, was well advised in leaving the question an open one, to be decided in each particular case by the Government of India The merits of the 2 ft 6 in gauge as that to be adopted in hill country or in special cases where continuity of gauge is either impossible for physical reasons or unimportant for traffic purposes, have recently been practically appreciated

In 1896, the Government of India issued a circular—Government of India, Railway Branch, P W D, No 514 R C of 1896 dated 17th April 1896—in which they described the encouragement and assistance they were prepared to give to private enterprise in the promotion of branch lines *

The Government of India cancel previous resolutions and summarise the concessions they are prepared to give for the construction of branch or feeder railways, not, as a rule, to exceed 100 miles in length larger or more important railways and mountain branches being excluded

The main line administrations interested will have a prior right to construct branch lines forming feeders

The Government of India will publish lists of branch lines, for the construction of which they are prepared to accept tenders, and will consider the inclusion in the lists of such lines as may be suggested by others

Applicants must be able to command financial support, the gauge must be approved, the railway shall be subject to the Indian Railways Acts, the alignment, etc, must be approved, and the railway be built in accordance with standard dimensions, the line, while under construction, shall be subject to Government inspection, and financial assistance may be afforded by the Government of India, either as—

(*a*) An absolute guarantee of a minimum dividend (not exceeding 3 per cent) in rupees (on capital expenditure in rupees), with such share of surplus net profits as may be agreed upon, or

(*b*) A payment by the main line sufficient—with the branch company's share of branch earnings—to give the company a dividend of 3½ per cent on capital expenditure in rupees, but in no case to exceed the net earnings of the main line on interchanged traffic, all net earnings of the branch over 3½ per cent to go to the company

In either case—(*a*) or (*b*)—capital raised in sterling will be entered in the company's books in India in rupees at the actual rate

* Appendix VII

The prospects of this line were not so favourable as to induce the Punjab Government to undertake its promotion

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(*b*) A payment by the main line sufficient—with the branch company's share of branch earnings—to give the company a dividend of 3½ per cent on capital expenditure in rupees, but in no case to exceed the net earnings of the main line on interchanged traffic, all net earnings of the branch over 3½ per cent to go to the company

In either case—(*a*) or (*b*)—capital raised in sterling will be entered in the company's books in India in rupees at the actual rate and time of remittance, together with English outlay from time to time at the Secretary of State's average rate for the preceding half year

The general character of the supervision and control of the Government is then defined, in regard to capital expenditure, increase

* Appendix VII

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The main line administrations interested will have a prior right to construct branch lines forming feeders

The Government of India will publish lists of branch lines, for the construction of which they are prepared to accept tenders, and will consider the inclusion in the lists of such lines as may be suggested by others

Applicants must be able to command financial support, the gauge must be approved, the railway shall be subject to the Indian Railways Acts, the alignment etc, must be approved, and the railway be built in accordance with standard dimensions, the line, while under construction, shall be subject to Government inspection, and financial assistance may be afforded by the Government of India, either as—

(a) An absolute guarantee of a minimum dividend (not exceeding 3 per cent) in rupees (on capital expenditure in rupees), with such share of surplus net profits as may be agreed upon, or

(b) A payment by the main line sufficient—with the branch company's share of branch earnings—to give the company a dividend of 3½ per cent on capital expenditure in rupees, but in no case to exceed the net earnings of the main line on interchanged traffic, all net earnings of the branch over 3½ per cent to go to the company

In either case—(a) or (b)—capital raised in sterling will be entered in the company's books in India in rupees at the actual rate and time of remittance, together with English outlay from time to time at the Secretary of State's average rate for the preceding half year

The general character of the supervision and control of the Government is then defined, in regard to capital expenditure, increase

* Appendix VII

of share or stock capital, permission to borrow, accounts and statistics, audit, etc

Funds for new capital works, required after opening, must be provided by the company

State railways' regulations regarding rates and services will apply

The additional concessions admissible are then stated These include —

(1) The charge of interest during construction,
(2) The free grant of land (but not of land required for quarries, ballast, brickfields, etc),
(3) The supply and maintenance of electric telegraphs by the Government of India at the usual charges,
(4) The free use of results of existing surveys, and the preparation of fresh surveys on deposit of estimated cost,
(5) The construction of the branch by the main line, and its maintenance and working by it at a fixed ratio of expenses to earnings, the ratio not to exceed 50 per cent, and to include charges for the use of the main line stock,
(6) The incidence of expenses on account of the Board of Direction,
(7) The carriage of railway materials for the branch over State lines at the special rates

The Government of India reserve —

(1) The right to purchase the branch for twenty five times the yearly average net earnings (not including rebate payments of the preceding three years) at the expiry of twenty one, thirty one, forty one, etc, years, on twelve months' notice, with a maximum price of 120 and a minimum of 100 per cent of cost price on a rupee basis,
(2) The right to fix and vary the classification of goods and maximum and minimum rates of each class of goods and passengers, and
(3) A general control in respect to the number and timing of trains.

Several railways have been sanctioned under the branch line terms laid down in the resolutions of 1893, 1895, and 1896 One or two have been completed, and others are in course of construction

The Barsi Light Railway runs from Barsi Road—a station on the Great Indian Peninsula Railway, 234 miles from Bombay—to the town of Barsi, a distance of 21 75 miles It was originally sanctioned as a steam tramway project in December 1892, but, the promoters having appealed to the Secretary of State regarding certain terms

modifications The contract was executed on the 1st August 1895

By way of assistance, the company was to be allowed to use the road between Barsi Town and Barsi Road Station for the construction of a single line of railway. Any land required outside the road was to be acquired through the collector of the district, all expenses being borne by the company. The road had been constructed by the Government of Bombay in 1870 for the purposes of a light railway, with maximum gradients of not more than 1 in 100.

Government may determine the contract on 1st January 1917, or at the expiration of any subsequent period of ten years, by giving twelve months' notice. If the contract is so determined the Government is to pay to the company in England in sterling an amount equal to the total paid up capital, so far as such capital shall have been expended with the authorisation of the Secretary of State.

of permitting a wider margin on short lines of this kind is obvious —

Passenger fares	First-class, 24 pies per mile
	Second class, 12 pies per mile
	Third class, 8 pies per mile
	Fourth class, 3 pies per mile
	Luggage, 4 pies per maund per mile
	Horses, each 24 pies per mile
	Carriages, each 4 annas per mile
	Dogs, each 8 annas per 50 miles
	Parcels, under 7 seers for first 50 miles, 6 annas, beyond, 3 pies per seer for every 50 miles
Goods rates	Fifth class, 54 pies per ton per mile
	Fourth class, 36 pies per ton per mile
	Third class, 24 pies per ton per mile
	Second class, 18 pies per ton per mile
	First-class, 12 pies per ton per mile
	Food grains, 12 pies per ton per mile
	Coal, 10 pies per ton per mile

A maximum terminal charge of 1 anna per maund is allowed on all goods traffic, leviable both at receiving station or at station of delivery. Traffic booked through not liable for terminals at junctions.

The rates and fares are to be such as may from time to time be agreed upon between the Government and the working agency, subject to the conditions that they are to be within the maximum and minimum rates and fares in force on the East Indian Railway, and that the classification of goods is to be in accordance with that on the East Indian Railway.

The Barsi Light Railway was constructed on the *2 ft. 6 in. gauge* and was opened for traffic in March 1897. One side of the district and municipal roads was made over for laying the railway, which

occupies a width varying from 6 ft 3 in, where the line follows the gradient of the road, to 9 ft or so where the line rises to take the bridges A roadway of 12½ ft or more is left for carts on the

The sharpest curve has a
1 in 88 for a length of
35 lb steel, flat-footed
rails and steel sleepers, with 7 cubic feet of broken stone and moorum ballast to the foot run The fish plates, weighing 12½ lbs per pair, are 16 in long with four holes spaced 4 in apart, centre to centre The fish bolts are ½ in in diameter, with square necks, cup shaped heads, nuts 1 in square and $\frac{9}{16}$ in deep and Grover's patent washers The steel sleepers are 5 ft 6 in long, 6 in wide, and 3¼ in deep, weigh 50 lb each and are laid 10 to the 24 ft rail, the rail being fastened in the clips by steel keys, two of which are driven on the straight, and four with the B sleepers used on curves to allow widening of gauge as required On bridges wooden sleepers are used, every third sleeper being fastened down to the girders by two hook bolts, and the rail is secured to the sleeper by in dog spikes

The engine and rolling stock are described in Chapter XIV The engine is expensive and heavy, bringing a weight of nearly twenty tons on a wheel base of 8 ft 3 in This throws on each sleeper a maximum load greater than that on the metre gauge, and the cost of maintenance will probably be high even if the speeds are kept low

This added considerably to the cost of construction

The expenditure up to 30th June 1897 on this line was £77,986, or £3585 a mile which is a far higher figure than in the case of the Gaekwar's Dabhoi, the Cooch Behar, the Morvi, and other Indian lines constructed on the 2 ft 6 in gauge (Appendix IV) In fact it has been constructed, and equipped with rolling stock, as a first-class railway on a narrow gauge

The gross earnings for 17 4 weeks (March to June 1897) were Rs 55,347, or about Rs 150 per mile per week, a very satisfactory figure for a new line and it was expected to reach Rs 230 per mile

The Ahmedabad Parantij metre gauge line was opened for traffic to Talod in May, to Parantij in July, and to Idar Ahmednagar in October 1897 Its length is 54 80 miles The permanent way consists of 41¼ lb flat footed steel rails on deodar sleepers There are two bridges one of six spans the other five spans, of 60 ft The ruling gradient is 1 in 200, and the limiting radius of curve 1000 ft.

When the negotiations with the B B and C I Railway for the construction of this railway fell through, Messrs Killick, Nixon, &

Co, of Bombay, applied for a concession to take up the project on feeder line terms, offering to construct the line with rupee capital This offer was accepted by the Secretary of State, and, a concession having been given to the applicants, work was started in January 1896 The line was constructed by the B B & C I Railway Com

[illegible]

Government undertakes to construct (from funds supplied by the company), work, and maintain the line, through State or other agency, the necessary rolling stock being supplied by the working agency (The agency selected is the B B & C I Railway Company, with which an agreement for the purpose was entered into by Government in 1896) The charge to the Ahmedabad Parantij Company for the working, stocking and maintenance of the line is to be calculated half yearly at the same percentage of gross earnings as obtains on the Rajputana Malwa undertaking, but it is provided that the charge shall not in any year exceed 50 per cent of the gross earnings for that year The residue of the gross earnings, after deduction of the charge for working, etc, is payable to the A P Company

By agreement with the B B & C I Railway Company, the Government will allow to the Ahmedabad Parantij Company in respect of each calendar year, by way of rebate such a sum not exceeding 10 per cent of the combined shares attributable to the B B & C I and Rajputana Malwa Railways of the gross earnings from traffic interchanged between those railways, or either of them, and the A P Railway, as will, together with the net earnings of the A P Company, make up an amount equal to interest for the year at the rate of 4 per cent per annum on the actual capital expenditure The Government will also allow the Company the sum of Rs 5000 per annum towards the Company s office expenses and expenses of management

Rates and fares are to be such as may from time to time be arranged between the Government and the working agency, but it is provided that they shall be within the maximum and minimum rates and fares for the time being in force on the R M Railway The classification of goods is to be in conformity with that in force on the R M Railway

Government may determine the contract if, before the line is open for traffic, the company fail, on demand, to supply the funds required for its completion In case of such determination the Government will pay the company in rupees the fair value of the railway, works, and stores given up

Government may also, by giving twelve months' notice, determine the contract—

(1) On the 31st December 1917, or at the end of any subsequent period of ten years In this case the Government under

takes to pay to the company in rupees a sum equal to twenty five times the average yearly net earnings of the company during the last preceding five years, provided that such sum shall not exceed by more than 20 per cent the total capital expenditure of the company, nor be less than such capital expenditure, or

(2) On the 31st December 1946 In this case the Government will pay to the company in rupees an amount equal to the total capital expenditure

In 1894 or 1895 Mr James Currie, of Karachi, applied for a concession, on branch line terms, for the construction of the Ahmedabad Dholka section (32 miles), of the Ahmedabad Dholera Railway (78 miles) on the metre gauge The matter was said to be under consideration

During the year 1896-97 work was started on the following railways, which were sanctioned under the "branch line terms" resolutions of 1893, 1895 and 1896 —the Tapti Valley (standard gauge) Rail [illegible] gauge) Railway, the Hardwar [illegible] Mymensingh Jamalpur Subhan [illegible] the Sultanpur Bogra Kaliganj [illegible] last are in connection with the Eastern Bengal State Railway system

The Tapti Valley Railway will connect Surat on the B B and C I Railway with Amalner the present terminus of a branch from Jalgam on the G I P Railway, the length being 162 47 miles Work was [illegible] metre gauge, and 18 miles long Work was commenced in May 1896, and it was expected that the line would be opened for traffic before the end of 1897.

The alignment for extending the Hardwar branch of the Oudh and Rohilkhund State Railway to Dehra was finally located in January 1897 on behalf of the company by whom it is to be constructed There will be as much as 1600 ft. of tunnelling in it The length of the line is 34 miles

The two lines connected with the Eastern Bengal State Railway system are being constructed by State agency on behalf of the branch line companies, and will be worked by the railway The Mymensingh-Jamalpur Kaliganj is an extension of the Dacca section towards Sirajganj The Sultanpur Bogra Kaliganj line will tap the Assam traffic at an important point on the Brahmaputra River

Other developments of the Eastern Bengal State Railway, which may attract private enterprise, are a metre gauge line from Panchabibi eastward through Gaibandha to Kaliganj, and another westward to Gazol, which is on the route of a third line from Ranaghat to Raiganj This last should be broad gauge from Ranaghat through

Moorshedabad to Bhagwangola, and metre gauge from the Ganges through Gazol to Rajganj, running northward all the way. Other extensions which might be made are from Nator to Rampur Boalia, from Phulbari to Sumjhia, from Saidpur to Titalyah, from Rangpur directly north to the Teesta River, and from Lalmanir Hat to Dhomani, all on the metre guage; from Dacca westward to Sealo, to complete the gap in the railway communication at present filled by steamers on the Padda and Megna Rivers; and a broad gauge extension from Rajbari to Faridpur.

In addition to the above a survey was made in 1893 for a branch from Nelphamari on the E B S Railway to Jayganj, a distance of 8½ miles, at the request of a native gentleman who proposed to form a company and obtain a concession for the construction of the line. The concession was granted in 1895. The cost of construction was estimated at about Rs 24 819 a mile, and the traffic prospects were considered favourable.

The Cooch Behar State Railway—worked for the Maharaja by the

For purposes of comparison, a table (compiled from the Director General of Railways' Administration Report for 1894–95) will be found in Appendix IV, giving for certain railways the mileage, the cost, the gross earnings, working expenses and net earnings, the amount of passenger and goods traffic, the train mileage and the quantity of rolling stock. In the chapter on "Light Railways in Belgium," moreover, the cost of certain lines in India has been analysed and compared with the Belgian figures, the object being, as far as possible, to eliminate from the inquiry such exceptional lines as the Rajputana Malwa Railway and the Darjeeling Himalayan, and, above all, to destroy the impression that our examples of light railways must necessarily be taken from lines constructed on a metre or narrower gauge. As fair examples of Indian lines constructed in accordance with light railway principles, the following may be mentioned:—

(a) *Standard gauge.* Wazirabad Lyallpur (actual cost, Rs 40,531 per mile, including rolling stock), Lyallpur Khanawal (estimated cost, rolling stock not included, Rs 25,714 per mile), Hyderabad Shadipalli (Rs 30,112 per mile), Sialkot Branch, N W R (Rs 30,000 a mile, with second-hand rails and sleepers, no bridging, but expensive stations); Ganda Singh Branch, N W R (Rs 33,000 a mile, with second hand rails and new sleepers, cheap stations, but considerable bridging).

(b) *Metre gauge.* Rohilkund and Kumaon (two sections,

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Eastern Bengal State Railway system

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The line from Segowlie, on the Tirhoot section of the Bengal and North Western Railway to Paksaul on the borders of Nepaul, is on the metre gauge, and 18 miles long Work was commenced in May 1896, and it was expected that the line would be opened for traffic before the end of 1897.

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The Cooch Behar State Railway—worked for the Maharaja by the

single new railway was sanctioned during the year under the branch line terms of 1896, although as many as fifteen schemes were under consideration

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(b) *Metre gauge* Rohilkund and Kumaon (two sections,

Rs 38,353 and Rs 37,858 per mile), Palanpur Deesa (Rs 24,175 per mile), Cawnpore Burhwal (Rs 21,550 per mile), Jodhpore Bickaneer (two sections, Rs 20 141 and Rs 22 375 per mile), Oodeypore Chitor (Rs.25,894 per mile) Gaekwar's Mehsana (Rs 35,209 per mile), Jetalsar Rajkat (Rs 32 939 per mile)

(c) *Special gauges* Jorhat, 2 ft (Rs 29,029 per mile), Gaekwar s Dabhoi, 2 ft 6 in (Rs 26,306 per mile), Cooch Behar, 2 ft 6 in (Rs 33,450 per mile), Morvi, 2 ft 6 in (Rs 24,220 per mile) Kaunia Dharlla 2 ft 6 in (Rs 24,929 per mile)

The exceptional physical difficulties which had to be overcome in the construction of the Darjeeling Himalayan Railway sufficiently account for the high cost per mile of this 2 ft line, Rs 61 792, and it would be unfair to quote this as a normal figure for so small a gauge Moreover if the cost of the 2 ft 6 in Barsi Light Railway (£3585 per mile) may be expressed as Rs 53,775 per mile (taking Rs 1 as equal to 16d) it would seem that narrowness of gauge is its main claim to be classed as a light railway

Steam Tramways—In addition to railways, there are in India 119½ miles of steam tramways working outside municipal limits and 104 miles under construction Included in the latter are the Ranaghat Krishnagarh (2 ft 6 in), Mangaldai (2 ft 6 in), Howrah Amta (2 ft) and Howrah Sheakhalla In fact, the last two have since been completed by Messrs Martin & Co on behalf of the Bengal District Roads Tramways Company, and there seems to be a large field for undertakings of this description in Bengal

The Howrah Amta line is twenty nine miles and the Sheakhalla line twenty two miles long The stations are about two miles apart, so that traffic can be dealt with at frequent intervals Within the limits of Howrah speed is limited to six miles an hour and in the district to ten

With the liberal terms now held out by the Government of India to companies formed for the construction of light railways, the only obstacle to the attraction of British capital is the fluctuations in exchange English capitalists are afraid to risk money in India which may be returned to them at a heavy loss If, as the Secretary of State holds out hope, a gold standard be established, fixing the stable exchange of the rupee at 16d, subject only to the fluctuations of trade, British capital will find a profitable investment in the development of light railways in India

CHAPTER IX

LIGHT RAILWAYS IN IRELAND

CONTENTS —Irish railways assisted by Treasury loans—Baronial guarantees—Tramways Acts of 1860 1881 and 1883—Light railways constructed under these Acts—Too expensively constructed and worked—Not controlled by local authorities who had to bear the losses—Light Railways Act of 1889 a boon to main line companies and the people—Light railways constructed with State assistance under the Act of 1889 and 1890—Railways Act of 1896 compared with the English Act of 1896

Light Railways Constructed under the Acts prior to 1889 — Ireland, in the development of her railway systems, has never been able to preserve the same independence of State aid which has hitherto been so remarkable in England and Scotland From the very first, the Treasury has advanced money to railway companies, usually on the security of a mortgage on the undertaking, and the Government has not claimed, in consequence of affording this assistance, to exercise any more control over the details of working, rates, etc, than in the case of other railways Up to 1888, according to returns submitted to the Royal Commission held in that year, as much as £4,101,401 had been thus advanced, of this amount £2,921,414 had been repaid by the railways, £37,772 had been remitted by the Imperial Government, and the remainder was outstanding Up to 1893, the Treasury loans had reached £4,197,746, of which the railways had paid back £3,383,278

The railways also received public assistance in the form of guarantees of interest, secured upon the rates, by the baronies or local authorities of the districts traversed by the railways, and here, again, the public bodies assisting did not, therefore, interfere with the service or rates, although they were generally represented by one or more members of the Board of Directors nominated by them

To such aid from the State and local authorities must be added, in many instances, the private aid of landed proprietors in the form *of subscriptions of capital or guarantees of interest*

In the poorer districts however, when railways were often urgently required, there was little to attract capital, and legislation had not been favourable to the construction of light lines

By the Tramways Act of 1860, the compulsory acquisition of land was provided for, but projects had first to be submitted to the Grand Jury, then to the Lord Lieutenant in Council, and finally to Parl-

ment for confirmation by an Act The last formality was dispensed with in the following year By the Tramways Amendment Act of 1871, mechanical traction at a maximum speed of six miles per hour on roads and of three miles per hour in towns was permitted, and the maximum speed on roads was increased to ten miles per hour in 1881 But much more important than all these was the Tramways and Public Companies Act of 1883, the intention of which was, first of all, to throw the responsibility of railway development in poor districts upon the local baronies and then, perhaps, to share it with the Imperial Government Thus promoters would submit a project for a light railway to the Grand Jury, and the ratepayers might oppose it The approval of the Grand Jury would throw upon the rates of the whole country, or of so many baronies, charges, not for the interest only, but for deficits on working expenses, and even the obligation of working the line if it was abandoned by the promoters On the other hand, although the Grand Jury might nominate a director or appoint an auditor, it had no real control over the railway, so long as it was run by the promoters The project further required the acceptance of the Privy Council and, if opposition was still maintained, the confirmation of an Act of Parliament The last carried with it the obligation to repay the Grand Jury, either (a) interest on capital to the extent of 2 per cent, or (b) half the difference between the net receipts and the total guaranteed interest required, whichever might be smaller

Under the Tramways (Ireland) Acts, 1860 to 1883, have been constructed (excluding three or four lines worked by one or other of the great railway companies) 230 miles of light railways They * show total receipts of £55,625 (about £240 per mile), a total working expenditure of £57,856 (about £252 per mile, or 104 per cent of receipts), and a deficiency of £2231 (or £9 7 per mile) by way of net receipts The local ratepayers (with the exception of about £25,000 per annum falling to the charge of the Imperial Government) have to make good this deficit, and the whole of the interest on capital If we look up the Mitchelstown and Fermoy Light Railway in the returns we find that, of a 5 per cent rate of dividend 2 per cent is guaranteed by the Imperial Government and 3 per cent by the

The total capital of all these
ed by the great companies) is
£1,199,175 is guaranteed, either
at 4 or 5 per cent

The following have been quoted as the more favourable in their results of th
in the tabl
and Skibbe
The Clog
receipts of
Muskerry,

* *Railway Ret rns*, 1896

The Schull and Skibbereen, nd shows receipts of £2306, The Tralee and Dingle, 37 miles long, cost £4054 per mile, and shows receipts of £5891, against an expenditure of £9341 Thus, the proportions per cent of expenditure to receipts on these four lines are 104, 83, 146, and

Working Expenditure, Net Receipts and Rolling Stock of Light Railways authorised under the Tramways (Ireland) Acts, 1860 to 1883			Clogher Valley	Cork and Muskerry	Schull and Skibbereen Tramway and Light Railway	Tralee and Dingle
Length of Line in miles open		No	37	18	15	37
Maintenance of Way and Works	Working Expenditure	£	1329	1746	999	4017
Locomotive Power		,,	2[illegible]9	2371	1081	2319
Repairs of Carriages and Wagons		,,	573	593	319	411
Traffic Expenses		,,	146[illegible]	1996	557	1580
General Charges			743	592	318	653
Rates and Taxes		,,	70	43	9	44
Compensation for Goods		,,	19	14	Nil	7
Legal and Parliamentary		,,	31	3	85	35
Miscellaneous			130	508	Nil	275
Total Working Expenditure		,,	6889	7866	3368	9341
Total Receipts		,,	6850	9472	2306	5891
Net Receipts		,,	– 39	1606	– 1062	– 3450
Proportion per cent. of Expenditure to Receipts			101	83	146	159
Locomotives		No	6	5	4	5
Carriages Wagons, Trucks, etc		,,	95	78	54	50

one that

ase much ys, which is about £5700, a heavy price to pay for a 3 ft. gauge line They are too substantially built and too expensively worked, in accordance with Board of Trade traditions, for lines with such poor average traffic

receipts as £239 per mile The heavy expenses, due to the complicated preliminary procedure and the purchase of land, absorbed so much capital that none was left for profitable expenditure on purposes absolutely necessary to the development of traffic The administration of small lines as separate concerns is always expensive and the Act of 1883 had expressly ignored the great railway companies Above all the local authorities who had to stand all risks and bear all losses had no proper control over the petty companies who constructed and worked the lines the baronies were saddled with all the liabilities but were armed with none of those powers which should accompany responsibility

Accordingly the Royal Commission on Irish Public Works—to which reference has already been made—in 1888 reported that the preliminary procedure was expensive and complicated that the local authorities ought not to be liable for working expenses as well as interest on capital that the ability to promote such lines should be extended to existing railway companies that the adoption of a narrow

y should rather be

1889 1890 and

1896 —While the Act of 1883 expressly ignored the great railway companies in relation to tramways or light railways, the Light Railways (Ireland) Act 1889 [52 & 53 Vict] applies most particularly to them The promoters (a) may be an Irish railway company having a railway open for traffic or (b) may have an agreement approved by the Treasury for the working of the light railway by such a railway company, or (c) may apply under the provisions of the Act of 1883, for a baronial guarantee on a portion of the paid up capital of the light railway The Treasury might

with a free grant or a loan but wo

than £20 000 a year in addition to

appropriated of the £40,000 a year

nor should any capital sums granted exceed £600 000 in the aggregate, annual grants moreover, should be reduced in limit by 3 per cent on any capital grants, and capital grants would be similarly reduced by any excess of annual grant over and above the £42,000 a year mentioned above capitalised at 3 per cent It lay with the Lord Lieutenant in Council to declare that a light railway should be constructed between certain places for the development of fisheries or other industries that special assistance from the State was required, and that the application of the Act should cease if the light railway were not constructed within a certain period

No doubt this Act followed by the Railways (Ireland) Act 1890, and the Transfer of Railways (Ireland) Act, 1890—the last of which

mpany, with

o the main

lines upon

the easiest terms under these Acts Of twelve light railways agre

gating 237 miles, towards the construction of which State assistance has been given in the form of free grants unaccompanied by any embarrassing conditions, all but one—the Donegal and Killybegs, a 3 ft gauge line—have been constructed on the normal Irish gauge 5 3, and nearly all are worked by such railway companies as the Midland Great Western, the Great Southern and Western the Cork Bandon, and South Coast, etc But they reach important fishing grounds, more especially on the west coast they penetrate to the poorest districts in Donegal Mayo, Galway, Kerry, Cork Down and Sligo, and, if the main lines profit by the contributive traffic of lines for which the State and the baronies have provided the capital the people of these districts reap also the full advantages of long needed railways under the efficient management of the great railway companies That the latter are fairly prosperous may be conceded seeing that their average return on all descriptions of capital was 4 30 per cent as compared with 3 87 per cent in the United Kingdom in 1894 * That they could—or, as a matter of business, would—build, either on their own standard or as light railways, the lines we are discussing is not so certain or rather, this much is certain, that without the freely given help of the State, these lines would not have been constructed at the very time when they were most wanted Mr A J Balfour's Railway Act of 1889 was in fact, the sufficient means not only of dealing with an immediate and pressing distress, but also of extending the lasting benefits of railway communication to poor and isolated districts

The following is a list of these light railways †—

Name	Length in Miles	Working Railway Company
Achill Extension	8¼	Midland Great Western of Ireland
Ballina and Killala	8	Midland Great Western of Ireland
Baltimore and Skibbereen,	7¾	Cork Bandon and South Coast
Bantry Bay Extension	1¼	Cork Bandon and South Coast
Collooney and Claremorris	47	Waterford and Limerick
Donegal and Killybegs	18¾	Donegal
Downpatrick, Killough, and Ardglass	8	Belfast and County Down
Galway and Clifden	48¼	Midland Great Western of Ireland
Headford and Kenmare	19¾	Great Southern and Western of Ireland
Killorglin and Valentia,	26¾	Great Southern and Western of Ireland
Stranorlar and Glenties	24¼	Donegal
Westport and Mallaranny	18	Midland Great Western of Ireland

* 'Irish Railways and their Purchase by the State'—*The Railway World*, Feb 1896

† *Railway Returns* 1896

The estimated cost of the Donegal line, on the 3 ft gauge, the axle load being restricted to eight tons and the maximum speed to twenty five miles an hour, was as much as £6600 per mile Of the total capital required by the company specially formed for its promotion, £115,600 was a free grant from the Treasury and 1000 guaranteed capital If so light a line on a narrow gauge was to cost so much as £6600 per mile, we can easily conceive that the larger railway companies, which accepted Treasury grants covering less than this amount, for the construction of light railways on the standard gauge, to carry standard rolling stock, were prepared to spend money out of their own pockets, in order to build what were practically standard railway extensions or branches of the existing main lines

Finally, we have the Railways (Ireland) Act, 1896 [59 & 60 Vict cap 34], which brings Ireland more into agreement with the conditions prescribed for England and Scotland in the Light Railways Act, 1896 [59 & 60 Vict cap 48]

Thus, section 1 of the former corresponds with sections 4 and 5 of the latter, but differs from them inasmuch as it restricts State aid to an existing railway company, willing either to construct, work, and maintain the proposed railway, or to work and maintain it when constructed On the certificate of the Lord Lieutenant that the proposed railway is necessary for the development of a district too poor to induce the construction of the proposed railway without special assistance, the Treasury may agree to aid the existing railway company, willing to take up the proposed railway, by an advance, up to one half of the cost of construction, provided that landowners, local authorities, and other persons locally interested, have done their fair part by free grant of land or otherwise The advance may be a free grant or a loan at interest The Board of Works may determine the surveys, plans, and estimates, if those submitted be not approved, and in the congested districts may undertake the construction if this existing railway company will not do so

Section 4 corresponds with clause 6 of the English Act It limits the total amount of advances to £500,000 The required money may be lent to the Treasury by the National Debt Commissioners

Under section 3, certain provisions of the Tramways Acts—relating to baronial guarantees, tolls and rates of charge, deposits, interference of the country surveyor, etc —are not to apply On the other

from unfair increase of local rates under clause 2 (c), which corresponds with section 5 (1) (c) of the English Act

Powers of owners to grant land or advance money for a light railway are dealt with in section 5, which corresponds with section 19 of the English Act

Entry on land is provided for under section 6

The application of General Railway Acts is defined in section 8, which corresponds with section 12 of the English Act

Under section 10, any Grand Jury may, under certain conditions, present money in aid of the railway

Under section 13, this Railways (Ireland) Act 1896, together with the Transfer of Railways (Ireland) Act 1890—and the Tramways (Ireland) Acts as therein defined—and the Tramways (Ireland) Act, 1895 may be cited collectively as the Tramways (Ireland) Acts, 1860 to 1896

CHAPTER X

ROAD TRANSPORT AS AN ALTERNATIVE

heavy work—Messrs John Fowler & Co s agricultural and road engines—Tyres for traction engines—Traction wagons

Restrictions on use of Steam Locomotives on Roads—At the end of the first chapter it was observed that road transport—by road locomotives, traction engines and cars, auto motors, etc —might often supply the place of light railways

"A very important subject for consideration also in connection with the Light Railways Act'—said Sir John Wolfe Barry* in his presidential address to the members of the Institution of Civil Engineers in 1896—'and, in itself, is the future of auto motors as applied to the light traffic, whether of goods or passengers, to be accommodated by the proposed light railways, and no engineer can read the accounts of the results attained by auto-motors, or have seen the machines in operation, without recognising their promise for the future"

The difficulties opposed by the legislature to the use of steam engines on roads† were such as practically to restrict their use to agricultural work—threshing and steam ploughing for example—and to the conveyance of merchandise and heavy material, which could not so readily be hauled by horses This fact was borne out by evidence obtained in committee in 1896,‡ that the majority of traction engines escaped the payment of licence duty under the exemption granted to engines used solely for agricultural purposes

Road locomotives were held to be nuisances at common law It might take an owner three months to obtain from a Court of Quarter Sessions a licence to travel on the highway In country districts the

* *Min Proc Inst C E*, vol cxxvii, 1897

† M Laren on "Steam on Common Roads,' in *Min Proc Inst C E*, vol ciii, 1891

‡ *Report from the Select Committee on Traction Engines on Roads*, 1st July 1896

speed of a traction engine was limited to four miles an hour, and a man had to walk in front of it, at a distance of not less than twenty yards The road authorities had almost absolute power to forbid the use of certain bridges by such engines (which we must acknowledge to be only reasonable), and damage done by them had to be made good, which would not have been required if horses had been used for draught Moreover, urban authorities might embody in their local Acts clauses prohibiting the use of road locomotives in any street or in any road within their jurisdiction

The mechanical difficulties, complained of by owners of road locomotives, included the heavy grades on the roads, the sharp corners, and the sinkage of bad roads

The legal obstructions undoubtedly call for revision, and, to a considerable extent, for removal The mechanical difficulties depend upon the claims of this particular description of road traffic to be regarded as ordinary traffic, for which the ratepayer must provide efficient roads The question is whether traction engines can get outside the definition of extraordinary traffic furnished by Lord Justice Bowen (in the case of Hill v Thomas, 2 Q B, p 333) —

"Extraordinary traffic is really a carriage of articles over the road, at either one or more times, which is so exceptional in the quality or quantity of goods carried, or in the mode or time of user of the road, as substantially to increase the burden imposed by ordinary traffic on the road, and to cause damage and expenses thereby beyond what is common "

So long as they are covered by the term "extraordinary traffic,"

and if the escape of fire up the funnel was guarded by a grating in the smoke box just above the tube level Danger to life and property from scaring of horses was diminished by boxing in the machinery as in Hancock's carriages, and these also passed the steam into a silencing box which broke the blast Traction engines fitted with air-condensers went without much noise from the blast

In moving the second reading of the "Locomotives on Highways Bill," on the 30th June 1896, Mr Chaplin caused some amusement by expressing his belief that the light-road locomotive might become a dangerous rival of the light railway, that it would develop a big industry, tend to decrease railway fares, and prove to be of great advantage to agricultural interests in the transport of farm produce at a cheaper cost They were largely used abroad, especially in France

* *Min Proc Inst C E.*, vol ciii, 1891

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The "Locomotives on Highways Act 1896" [59 & 60 Vict cap. ... mechanical ... and drawing ... omotive not to exceed in weight unladen four tons), it must be so constructed that it shall emit no smoke or visible vapour except from any temporary or accidental cause A council of any county or county borough may prevent or restrict the use of such locomotives upon bridges which would be unsafe for them A proper light must be exhibited by the locomotive at night It must carry a bell to be used as a warning Its speed must not exceed fourteen miles an hour, or any less speed prescribed by the Local Government Board, which also retains the power of making regulations regarding the construction and use of these locomotives, and of prohibiting or restricting their use in crowded streets or other dangerous places An excise duty of two or (if the locomotive exceed two tons in weight) of three guineas, together with the license for the locomotive as a carriage or hackney carriage, is to be paid

Motor Cars relieved from some Restrictions —On the 14th November 1896, motor cars being no longer classed as traction engines, regulations, supplementary to the above Act, were issued by the Local Government Board, and some motor cars made a trip from Northumberland Avenue, *via* Reigate, to Brighton The "light locomotive" must be capable of being worked either forwards or backwards There may be bosses or projections on pneumatic tyres, if they are used, otherwise, wheel tyres must be smooth, with a breadth varying from 4 to 2½ inches, according to the weight of the vehicle Two independent brakes are required Any drawn vehicle, too, must have a brake, or the brakes on the locomotive must be able to control it The width of the locomotive must not exceed 6½ feet If drawing another vehicle, the name and address of the owner must be conspicuously painted on it and its weight, moreover, the weight must be painted on every locomotive weighing unladen 1½ ton and upwards These regulations fix the maximum speed at 12 miles an hour, if the weight be 1½ to 2 tons, the speed must not exceed 8 miles, and if the weight exceed 2 tons, the speed must not exceed 5 miles an hour, whatever the weight, if used to draw any vehicle, the speed must not exceed 6 miles an hour Of course, the ordinary rules of the road and of street traffic apply

The development of the motor car or light road locomotive, under the encouragement of the new Act, may take place in several directions Steam, oil, and electricity are all in the field, but, for town

various districts for hauling such articles as corn, manure, lime, drain age pipes, timber, bricks, and other building materials, stone for the roads, boilers, and heavy pieces of machinery, and sometimes for lighter goods, such as flour and groceries from co operative stores They are thus of great benefit not only to the agriculturist, but also to the builder, the manufacturer, the distributor, and the consumer. They are largely used by some local authorities and, to a considerable extent, by the War Department *They are e pecially useful in dis tricts where the railway communication is not good, and for the car riage of bulky articles which cannot conveniently be transhipped or conveyed by rail In such cases it is often not only cheaper but quicker and less injurious to the articles carried to convey them all the way by road rather than to and from the railway stations"*

Most of the traction engines escaped paying any license duty under the statutory exemption of engines used solely for agricultural pur poses They
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Their use in crowded streets of large towns in the daytime seemed more objectionable, and the
of the day in London, Ma
the other hand, no such
needed, in Leeds, Birmingham, Hull, Newcastle, and other important towns The noise and vibration were naturally considered nuisances in residential towns, but serious damage was mainly limited to places where the houses were badly built, where the weights carried were excessive, and especially where, as in Aberdeen, the streets were paved with granite sets The damage done to the metalled surface of ordinary roads was, however, considerable, while the owners were frequently not ratepayers within the county, and contributed little to the upkeep of the roads they used except the license duties In spite of this, the engine owners demanded that country, as well as town, roads should be maintained so efficiently as to bear the heaviest class of traffic likely to pass over them That, of course, was most unrea sonable, and the retention of "the extraordinary traffic clause" in the Act of 1878 (dealing with damage done to roads by extraordinary traffic or excessive weight) was strongly advised

Under the Act of 1878 the country authorities (and quarter-session boroughs, with a population of 10,000 and upwards, and the Common Council of the City of London) were empowered to make bye-laws regarding the hours of travelling, regulating the u e of locomotives
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bear in one county a locomotive could not travel by night, entering

another county it could not travel in the middle of the day. In regard to this, the committee very rightly observed —"Restrictions on locomotion are always in themselves objectionable, and can only be justified by necessity or grave inconvenience We think, therefore, that on principle the prohibitions on engines travelling should be made as light and as uniform as possible" The making of closing bye laws could not be placed in the hands of a central authority like the Local Government Board, local authorities could best appreciate the circumstances of each district, but they must use their power reasonably The Committee, therefore, while recommending that local authorities should have no general powers of prohibiting the use of these engines within their county or county borough *as a whole*, considered that they should retain their present powers of making bye laws to regulate their use upon any highway, and to prohibit their use in crowded streets or narrow roads or particular localities for special reasons

Then, in regard to license duties, " — - ' ' '
on the borders of several counties,
have to pay the maximum duty of
in more than one county Here, again, an Imperial license duty seemed to be the obvious remedy, but the division of the revenue among the various local authorities concerned would be difficult, and local registration would be useless as local control would be rendered impossible A statutory duty of £10 was advised, payable to the county, in which the engine was chiefly used, and the engine should have a right of passing through any other county on payment of a registration fee of 2s 6d Additional duty, at the rate of £2 per additional ton, should be paid for engines weighing over 10 tons Steam rollers should be exempted from license duties, as are agricultural engines

While expressing their opinion that the number of loaded trucks or wagons drawn by an engine should not exceed three (exclusive of a water barrel), without the written consent of the surveyor, the Committee prepared to leave any restriction of the maximum length of the train to be prescribed by the local authorities in their bye laws

The speed had hitherto been restricted to four miles an hour in the

mendations —

I — iat the limit of speed be maintained at four miles an hour in the country, but be raised from two to three miles an hour in towns and villages.

II —That engines be authorised to be used with driving wheels of

any form of construction that may be from time to time approved by the Local Government Board

III —(*a*) That in addition to the two men in charge of an engine in motion, a third man should be required to accompany it, not necessarily in advance or on foot, but in such a manner as to be best able to assist horses passing either from the front or from the rear

(*b*) That the fourth attendant be dispensed with in the case of trains consisting of three wagons or less

(*c*) That in the case of two plough engines with their necessary gear closely following each other, only five men should be required in attendance

(*d*) That one of the three attendants be required to remain with an engine while stationary on a highway, and having its fires alight

(*e*) That at night every engine or train of wagons should carry a conspicuous red light in the rear, and that all lights should be fitted with shutters or screens

IV —(*a*) That a penalty not exceeding £10 be recoverable summarily for carrying weights on wagons in excess of those authorised by 24 & 25 Vict cap 70, s 4, without the consent of the cou

(*b*) That a similar penalty such consent a numbe exclusive of a water barrel

V —(*a*) That local authorities should have no general powers of *prohibiting the use of engines for specified hours within* their county or county borough as a whole

(*b*) That local authorities should retain their present powers of making bye laws to regulate the use of engines upon any highway and should also have power by bye law (subject to confirmation by the Local Government Board) to prohibit their use in crowded streets, or narrow roads, or in special localities for special reasons

VI —That in all cases where a bridge is closed against traction engine traffic by order of a local authority, an appeal should lie to an arbitrator appointed by the Local Government Board

VII —(*a*) That a uniform annual license duty of £10 be paid by the owner (or user) of each engine of not more than ten tons in weight, exclusive of water and coals, with an addition of £2 per ton for every extra ton

(*b*) That a license may be transferred from one engine to ner with the consent

(*c*) council receiving the duty be required to provide a license plate with the name of the county or borough, the number and date to ig the

(*d*) Tl pass through any other county or county borough on payment of an annual registration duty of 2s. 6d for each county or county borough.

(*e*) That steam rollers (as well as agricultural engines) be exempt from license duty, but that all engines be

(*f*) T

other agricultural purpose, and any engine the property of one or more occupiers or owners of agricultural land, employed solely for the purposes of their farms or estates, and not let out for hire.

(*g*) That similar license duties be levied in Scotland and Ireland

VIII —That the extraordinary traffic clause [41 & 42 Vict cap 77, s. 23] should be amended as follows —

(*a*) The time for the recovery of expenses to be limited to a period of twelve months from the damage complained of, or (in case of a particular contract or building job) of six months from the termination of the work

(*b*) The expenses to be recoverable from any person by whose order "or for whose benefit" the work is done

(*c*) The expenses not to be recovered before justices, but in the County Court, or, in case of large amounts, in the High Court

In Scotland an appeal should be allowed from the Sheriff's Court to the Court of Session, in order to secure uniformity in the decisions

The Clause should be extended to Ireland

IX —That the amount of the penalties for various offences should be revised, and that the law as amended should be consolidated in one Statute for the United Kingdom *

Traction engines already do a great deal of the kind of work that light railways propose to do, and their emancipation from the

* The Locomotives Act, 1898 (61 & 62 Vict. c 29), has since been passed It is dated 2nd August 1898

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IX —That the amo
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Traction engines al
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* The Locomotives Act
is dated 2nd August 189

anomalies and penalties of the old Acts and local bye laws would give them a fair field There is little doubt that *steam* traction will continue to hold that field, as in the past Of the use of such engines we are reminded in the Report of the Select Committee Heavy parts of machinery, boilers, trees, blocks of stone, etc , are more conveniently conveyed by them over moderate distances very often, than if such bulky articles were carried *to* the railway, *by* the railway, and *from* the railway to their destination The cost of working has been estimated* to be about 2d per ton per mile

Of these engines Messrs John Fowler & Co (Leeds) manufacture two types The first (Plate I fig 1) is designed for agricultural purposes and general work about a farm or estate, such as occasional haulage driving any belt-driven machinery, pumps, saws, pile driving hoists threshing machines, chaff cutting machines, dynamos, etc The second type, generally known as road locomotives (Plate I fig 2), is specially designed for continuous heavy haulage and long journeys on roads, the working parts of the engine being screened to hide them as far as possible from horses

The gearing in engines of the second type is of extra strength, the bearings and journals are of larger size, and the tank and bunker capacity are increased to carry a greater quantity of water and fuel The driving wheels are of large diameter, giving greater adhesion on

run a mile in $5\frac{1}{4}$ minutes when time was precious The compound principle and spring mounting are a *sine qua non* of this type of engine The rear axle spring arrangement is based on powerful twin springs, the parts being so arranged that when either driving wheel comes in contact with any obstacle on the road the other wheel takes its share of the shock, the movement being compensated by transverse levers The third motion shaft and rear axle bearings are connected, and move simultaneously—in response to the elastic movement of the

Details and prices are quoted in the following list To the prices

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ope, a steam water

* Maclaren on "Steam on Common Roads," *Min Proc. Inst C E*, cııı., 1891

anomalies and penalties of the old Acts and local bye laws would give them a fair field There is little doubt that *steam* traction will continue to hold that field, as in the past Of the use of such engines we are reminded in the Report of the Select Committee Heavy parts of machinery, boilers, trees, blocks of stone, etc , are more con veniently conveyed by them over moderate distances very often, than if such bulky articles were carried *to* the railway, *by* the railway, and *from* the railway to their destination The cost of working has been estimated* to be about 2d per ton per mile

Of these engines Messrs John Fowler & Co (Leeds) manufacture two types The first (Plate I fig 1) is designed for agricultural purposes and general work about a farm or estate, such as occasional haulage, driving any belt driven machinery, pumps, saws, pile driving hoists, threshing machines, chaff cutting machines, dynamos etc The second type, generally known as road locomotives (Plate I fig 2), is specially designed for continuous heavy haulage and long journeys on roads, the working parts of the engine being screened to hide them as far as possible from horses

The gearing in engines of the second type is of extra strength, the bearings and journals are of larger size, and the tank and bunker capacity are increased to carry a greater quantity of water and fuel The driving wheels are of large diameter, giving greater adhesion on

run a mile in $5\frac{1}{4}$ minutes when time was precious The compound principle and spring mounting are a *sine qua non* of this type of engine

springs, th

comes in

its share of the shock, the movement being compensated by transverse levers The third motion shaft and rear axle bearings are connected, and move simultaneously—in response to the elastic movement of the spring between the horn blocks—thus giving similar freedom of motion to that which we appreciate in the railway locomotive At the same time, these engines can be used for belt-driving or any purpose to which the agricultural engine is otherwise applied

Details and prices are quoted in the following list To the prices

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ed firebox, awning,

In the prices are

ope, a steam water

* Maclaren on "Steam on Common Roads,' *Min Proc Inst C E*, cui, 1891

	Class	Single Cylinder D	Single Cylinder A	Single Cylinder B	Single Cylinder C	Compound Cylinder D	Compound Cylinder A	Compound Cylinder B	Compound Cylinder C
Agricultural Traction Engines	Actual horse power	14	22	30	38	15	24	33	42
	Diam of ordinary wheels	5 1½	5 6	6 0	6 6	5 1½	5 6	6 0	6 6
	Width of "	1 2	1 4	1 4	1 6	1 2	1 4	1 4	1 6
	Diam of fly wheel	4 0	4 6	5 0	5 0	4 0	4 6	5 0	5 0
	Width of "	5 in	6 in	6 in	7 in	5 in	6 in	6 in	7 in
	Revolutions per minute	180	150	150	150	180	150	150	150
	Price	£360	£410	£465	£530	£415	£465	£540	£630
Special Road Locomotives	Actual horse power		22	30			24	33	
	Diam of ordinary wheels		6 6	7 0			6 6	7 0	
	Width of "		1 4	1 6			1 4	1 6	
	Diam of fly wheel		4 6	4 6			4 6	4 6	
	Width of "		6 in	6 in			6 in	6 in	
	Revolutions per minute		150	150			150	150	
	Price		£490	£560			£550	£635	

Both types of engines are constructed either on the single cylinder or compound principle There is no doubt that the compound locomotive is coming into more general use The boiler can be reduced in size, there is a saving in fuel and water, the noise from the exhaust in the chimney is suppressed, and, for emergent purposes, high pressure steam may be admitted into the low pressure cylinder

These engines are provided with multitubular boilers ventilated fire hole doors, and ash pans with adjustable dampers and may fairly claim to be considered as smoke consuming They are fitted with ... prevent the dropping ... no noise

... r driving ... cylinder agricultural traction engine (the nominal weight of which is about 8½ tons or when full 9¼ tons) places roughly 7½ tons of this upon the

"drivers" and only 2 tons upon the steering or front wheels Their class A4 compound road locomotive (the nominal weight of which is about 10 tons or when full 11¼ tons) places roughly 9 tons of this upon the "drivers" and only 2¼ tons on the "steerers" It will be

but very level ground In the *Report of the Select Committee on*

bedded upon pliable pads, and loosely held in their sockets by spring bolts, so that from three to five of these pads come in contact with

than the diagonal cross bars if the blocks became worn down It seemed more necessary, therefore, to direct attention to the *condition* than to the *kind* of tyre adopted

Traction wagons may be mounted on springs or constructed with solid axle beds as required, and Messrs John Fowler & Co build them to suit any particular description of transport The fore-
the engine—is fitted with a turn-
means of a triangular coupling bar
n engine The coupling bar has a
double acting, spring drawing bar arrangement, which comes into action in starting as well as in steering

circle, and 6 tons on the rigid or rear axle For the discharge of broken road metal, bricks, lime, etc, special traction wagons are built, the bodies of which, by an arrangement of rack, roller, and lever, may be moved to either side and tilted by gravity.

		Single Cylinder				Compound Cylinder			
	Class	D	A	B	C	D	A	B	C
Agricultural Traction Engines	Actual horse power	14	22	30	38	15	24	33	42
	Diam of ordinary wheels	5 1½	5 6	6 0	6 6	5 1½	5 6	6 0	6 6
	Width of	1 2	1 4	1 4	1 6	1 2	1 4	1 4	1 6
	Diam of fly wheel	4 0	4 6	5 0	5 0	4 0	4 6	5 0	5 0
	Width of	5 in	6 in	6 in	7 in	5 in	6 in	6 in	7 in
	Revolutions per minute	180	150	150	150	180	150	150	150
	Price	£360	£410	£465	£.30	£415	£465	£540	£63(
Special Road Locomotives	Actual horse power		22	30			24	33	
	Diam of ordinary wheels		6 6	7 0			6 6	7 0	
	Width of		1 4	1 6			1 4	1 6	
	Diam of fly wheel		4 6	4 6			4 6	4 6	
	Width of		6 in	6 in			6 in	6 in	
	Revolutions per minute		150	1'0			150	150	
	Price		£490	£560			£550	£635	

Both types of engines are constructed either on the single cylinder or compound principle There is no doubt that the compound loco use The boiler can be reduced l and water, the noise from the sed, and for emergent purposes, high pressure steam may be admitted into the low pressure cylinder

These engines are provided with multitubular boilers ventilated fire hole doors and ash pans with adjustable dampers and may fairly claim to be considered as smoke consuming They are fitted with steel plate pressed ash pans to carry water and to prevent the drop-

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"drivers" and only 2 tons upon the steering or front wheels Their class A4 compound road locomotive (the nominal weight of which is about 10 tons or when full 11¼ tons) places roughly 9 tons of this upon the "drivers and only 2¼ tons on the steerers' It will be

but very level ground In the *Report of the Select Committee on*

tacitly permitted in many districts They consist of wood blocks, bedded upon pliable pads, and loosely held in their sockets by spring bolts, so that from three to five of these pads come in contact with the ground at the same time, distributing the pressure and diminishing the noise But although they were harmless to pavements if the blocks were in good repair, they might actually cause more damage than the diagonal cross-bars if the blocks became worn down It seemed more necessary, therefore, to direct attention to the *condition* than to the *kind* of tyre adopted

Traction wagons may be mounted on springs or constructed with solid axle beds as required and Messrs John Fowler & Co build them to suit any particular description of transport The fore

the engine—is fitted with a turn

double acting, spring drawing bar

action in starting as well as in steering

There are, of course, many types of traction wagons (Plate I fig 3), and some have a turntable fore carriage at each end, which is convenient where the space for loading or discharging is limited Among others, the writer noticed a traction wagon weighing 3 tons and carrying a load of 8 tons The total weight was distributed on the wheels so as to relieve "steerers' to some extent, 5 tons being carried on the leading axle, which was fitted with a pivoting or turning circle, and 6 tons on the rigid or rear axle For the discharge of broken road metal, bricks, lime, etc, special traction wagons are built, the bodies of which, by an arrangement of rack, roller, and lever, may be moved to either side and tilted by gravity

CHAPTER XI

THE LIGHT RAILWAYS ACT, 1896

CONTENTS —First use of term "light railway" in an Act of Parliament—

THE LIGHT RAILWAYS ACT, 1896

Summary of earlier Legislation.—The first actual use in an Act of Parliament of the term "light railway' occurs in section 27 of the Regulation of Railways Act, 1868 [31 & 32 Vict cap 119], under which "the Board of Trade may by license authorise a company applying for it to construct and work, or to work as a light railway, the whole or any part of a railway which the company has power to construct or work" Section 28 prescribes that, on such lines, the axle load shall in no case exceed 8 tons, nor the rate of speed of trains exceed 25 miles an hour, but, subject to these maxima, a light railway may be constructed and worked under such conditions and regulations as the Board of Trade may from time to time impose or make The limitations of the axle load prevented the circulation of main line stock, and assisted to render the Act inoperative

There is an earlier and equally abortive Act, the Railways Construction Facilities Act, 1864 [27 & 28 Vict cap 121], designed "to

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land required, and their subsequent procedure is thus prescribed —

"(1) They shall apply to the Board of Trade for a certificate under this Act

"(2) They shall deposit maps, plans, sections, and books of reference, and an estimate of the expense of the construction of the railway, and lodge a draft of the certificate as proposed by them, according to the general rules of this Act.

"(3) They shall publish notice of the application according to such general rules."

The Board of Trade may then, after considering all representations and objections, settle a certificate authorising the making of the railway. This draft certificate is to be laid before the Houses of Parliament, either of which may stop it, which involves the upsetting of all contracts for land. Otherwise, being approved, the Board of Trade may issue and publish in the *London Gazette* the certificate, which is thenceforward to have the same force as would a special Act.

With the certificate are to be incorporated the Lands Clauses Acts and the Railways Clauses Acts, *except those provisions which give compulsory powers, etc.*

The Board of Trade has power to incorporate a company by the certificate, in which case the Companies Clauses Acts are to be included in the certificate.

With a view to ensuring the completion of the railway, the promoters are obliged to deposit 8 per cent. on the estimate in the Court of Chancery.

The maximum tolls and charges are specified in the schedule, *e.g.* — Third class passengers, 1½d. per person per mile; minerals, etc., in class 7 goods, 1½d. per ton per mile. But the Board of Trade has power to vary these, and they do not include a reasonable charge for loading, covering, and unloading at stations (terminal charges), and for delivery, collection, etc.

It may be asked to what extent the development of light railways was encouraged by such facilities as were afforded by these two Acts, and, after they have been in force for nearly thirty years, the answer is given in the Report of a Committee presented (in January 1895) to the Right Honourable James Bryce, M.P., Chairman of a Conference on Light Railways:—

"Practically no light railways have been constructed under the general Acts of 1864 and 1868, owing in part, it is alleged, to the consent of all landowners and other parties beneficially interested and the absence of opposition from any railway or canal company, being necessary before the Act can be made use of.

"The mileage of such lines constructed under special Acts has also been inconsiderable.

"This lack of progress in rural districts has also been in great measure due to the want of latitude left to the Board of Trade by law, and, in other cases, to the conditions which the Board considered it their duty to impose for the public safety."

The more power was given to the Board of Trade to call upon the railways to provide safety appliances, the less able was that Depart

ment to relax their demands in favour of any particular railway, however poor it might be, and however extravagant and unnecessary was such an equipment for a line whose traffic was sufficiently served by few and slow trains The climax was reached in 1889 The Regulation of Railways Act, 1889 [52 & 53 Vict cap 57], enacts that "the Board of Trade *may* from time to time *order* a railway company" to adopt the block system on passenger lines, to interlock their points and signals, and to use on all their trains continuous brakes which must be instantaneous in action, applicable by the driver and the guards, self applying in the event of failure in any of the brake parts, etc The word "may" has no suggestion of compulsion to the casual reader, and the following qualification—"In making any order under this section the Board of Trade shall have regard to the nature and extent of the traffic on the railway, and shall, before making any such order hear any company," etc —seems, at first sight, to leave it open to the Board of Trade not to enforce such requirements where they are obviously unreasonable Nevertheless, the writer in 1891 and 1892—while on special duty under the orders of the Secretary of State for India—found a poor line like the Cambrian (whose gross traffic receipts at the present moment may be about £21 per mile per week) as busily employed in providing safety appliances as the London and North Western Railway (whose gross receipts are very nearly £119 per mile per week) Indeed, the Cambrian had much more to do, comparatively speaking, for the London and North Western line was practically fully equipped already, in compliance with an enormous movement of traffic which rendered the most perfect appliances for safe working absolutely necessary

The fact is an Act like this, which empowered the Board of Trade

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examine the Light Railways Act, 1896 [59 & 60 Vict cap 48],* and see what facilities it affords for the development of light railways in Great Britain

While this Act applies to light railways, it does not define them

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on the Light Railways

"A railway shall be deemed to be a light railway if the cost of construction thereof, exclusive of land, legal charges, and rolling stock, shall not exceed £3000 a mile, and if the speed shall not exceed,

* Appendix VIII.

inclusive of stoppages, 16 miles an hour outside of towns and villages and 6 miles an hour inside of towns and villages and if the weight of the locomotives, coaches, and wagons shall not exceed 8 tons per axle"

We may safely say that a light railway is one which on account of the nature and amount of the probable traffic must, if it is to be constructed at all, be of a lighter character more cheaply built, more economically equipped, less hampered by safety regulations, and more simply worked than a standard railway The distinction between one and the other will be more or less marked according to circumstances, but it would be impracticable to make this distinction depend separately upon weight of rail, gauge of line maximum axle load maximum speed, or any of the many details which make up the *potential* of a railway

On the other hand, the distinction between a light railway and a tramway cannot be absolutely drawn, and the question will constantly arise whether a scheme should be dealt with under the Tramways *Act or under the Light Railways Act.* The average Englishman's notion of a tramway is practically confined to street tramways, where the head of the rail is grooved to take the flange of the wheel, not plain, as on railways, to support the tread of the wheel, while the tram rail is sunk so that the head is flush with the surface of the road, and the arrangement of the permanent way is such as enables block paving or metalling to be laid down between and outside the rails This is certainly the sort of tramway contemplated in the Tramways Act [33 & 34 Vict cap 78] of 1870 Section 25 of that Act prescribes that the uppermost surface of the rail shall be on a level *with the surface of the road, section 28 deals with repairs of the* metalled or paved surface of the road where the tramway is laid, and [illegible]

indicate such re-

on the Continent

[illegible] than we are, and, when these are laid on one side of the road, they do not generally present the same physical features as our street tramways Thus, in France, a tramway is a line which runs for more than two thirds of its whole length on or along the sides of the public roads, and one which does so for a less distance is a railway So, too, in *England, we have the Wisbech and Upwell tramway,* constructed by the Great Eastern Railway, running along the side of a public road, but retaining nearly all the physical features of a railway; the reason for applying the term tramway to this line would seem to be legal rather than technical, for, there being no Light Railways Act, *it had to be constructed under the Tramways Act The Wisbech* and Upwell trams, however, will take up and set down passengers by the wayside, which all tramways are supposed to do, whereas most rail- [illegible]

other

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One

[illegible] reasons of the inability of the Tramways *Act to meet* the want which the Light Railways Act is intended to supply, was that it

proved useless for the carriage of goods It was only with the assistance of the railway companies, or when they actually belonged to a railway company (as in the case of the Wisbech and Upwell Tramway), that tramways could successfully deal with goods traffic In such cases, if the rail and gauge would admit of the passage of

that, even if the Tramway Company maintained the portion of the road covered by their track and for a distance of 18 inches beyond their rails, the great bulk of ordinary street traffic was driven to that portion of the road which the local authorities had to repair, and the cost

The Light Railways Act of 1896 will, it is hoped, afford no opportunity for such discouragement of useful schemes, but the Tramways Act will still remain for the benefit of lines constructed under the Act, as well as for those proposed lines which are entitled to be classed as tramways Before leaving the subject of tramways it may be mentioned (as in Chapter I) that tramroads, as distinguished from tramways, are only dealt with in a Standing Order of the Houses of Parliament

Under section 1 of the Light Railways Act is "established a commission, consisting of three commissioners, to be styled the Light Railway Commissioners, and to be appointed by the President of the Board of Trade" They are the Earl of Jersey, G C M G, Chairman, Mr G A Fitzgerald, Barrister at Law, and Colonel G F O Boughey, R E, C S I, who was for many years manager of two of the great Indian State Railways Their duty is to "carry the Act into effect and to offer every facility for considering and maturing proposals to construct light railways," in other words not to block a scheme by applying every condition that may relieve an official department of responsibility, but to give it all reasonable encouragement and assistance The Commissioners have liberally accepted and acted upon this principle, and in time, no doubt, the Board of Trade will find less difficulty in adapting their requirements to the new class of railway

Under section 2, an application—preceded by compliance with section 7 (1) and (2)—for an order authorising a light railway may be made to these commissioners by the council of any county, borough, or district, through any part of which the proposed railway is to pass, by any individual, corporation, or company, or by any of these jointly Parish councils are not mentioned

The rule * made by the Board of Trade—"to regulate the procedure before the Light Railway Commissioners where a scheme for a light railway has been matured, and it is intended to make a formal application for an order"—are quoted in Appendix IX.

Section 3 gives to the county, borough or district council if authorised by an order, power to undertake or to contract for the construction or working of the light railway, to advance to a light railway company—either as a loan, or as part of its share capital or partly in one way and partly in the other—any amount authorised by the order, or to join any other council, person, or body in doing any of these things or any such other act incidental to them as may be authorised by the order. The council's application must, however, be supported † by a special resolution of the council, passed after a month's previous notice, and by two-thirds of the members present and voting. Moreover, if the light railway be wholly or partly outside their area the council can take no action in the way of construction, working, contract, or advance except *jointly* with the council of the outside area, unless they satisfy the Board of Trade that such action is expedient in the interests of their own area, and even then, their expenditure will be limited by the order to an amount proportionate to the benefit that may accrue to their area.

Thus a council may keep the whole of the undertaking in its own hands, and be altogether independent of contractors. Or they may construct the line by contract, and they may lease the working in which case

If a cou
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amount for the time being advanced by the council, provided that one half of the total amount is subscribed as "share capital," and of that share capital at least one half has been paid up by persons other than local authorities. Such a Treasury loan is to bear interest at not less than $3\frac{1}{2}$ per cent per annum. We have here the first mention of
bu

tional circumstances. Where the Treasury is satisfied, by a certificate from the Board of Agriculture or the Board of Trade, that a light railway is necessary in the interests of agricultural, fishing, or other definite industry, and the line would not be made without such assistance, the Treasury may aid the railway out of public money by a special advance, either as a free grant or as a loan, not necessarily bound by the terms of loan laid down in the previous section, provided that those locally interested have properly supported and assisted the scheme, provided also that an existing railway company will undertake to construct and work the railway, but the special

* *Statutory Rules and Orders* 1896, No 787.
† First Schedule to the Act.

advance is not to exceed one half of the total cost of construction, and the railway may be guarded, in any parish, from an assessment of local rates higher than that imposed when the railway land was acquired We, in India, know how much railways may have to pay out of their own pockets on account of land, previously worthless, which has simply acquired its present value from the adjacent railway

Section 6 limits the total amount advanced by the Treasury at any one time to £1,000 000, of which not more than £250,000 may consist of special advances The Treasury may borrow from the National Debt Commissioners money required for the purpose of advances

Section 7 deals with the consideration of the application by the Light Railway Commissioners

They must satisfy themselves that the local authorities, including the road authorities, and owners and occupiers of the lands it is proposed to take up have been duly consulted, and that public notice of the application has been given The Commissioners must also obtain by local inquiry and by such other means as they think necessary, all material and useful information for dealing with the application

The applicants must satisfy the Commissioners that they have published advertisements in a local newspaper as prescribed in section 7 (2) (*a*), that they have served notices on, and obtained the agreement or objections of every reputed owner, lessee, and occupier to the taking of his land The publication of an advertisement, two weeks running in a local newspaper, of the land required, naming a place where a plan of the proposed works and required land may be seen, etc, disposes of an expensive detail Hitherto railway promoters have had to pay for long advertisements in local and other plans, book of reference, and sections required

The Commissioners must hear and consider all objections to the application, whether made formally or informally

They may then settle the draft order submitted by the applicants, and insert further provisions for the public safety, particulars of the land required, conditions in regard to construction and working, etc, if such are required

This order would be provisional only, not having effect until confirmed by the Board of Trade, as provided under sections 8, 9, and 10 of this Act

If the Commissioners refuse an application, the applicants, if the council of any county, borough, or district, may appeal to the Board of Trade, who may remit the application to the Commissioners for further consideration.

The Commissioners must submit their order—with particulars, plans, statement of objections, report thereon, etc —to the Board of Trade,

* Appendix IX, *Statutory Rules and Orders*, 1896

as prescribed in section 8, and the Board of Trade … notice of the order and receive objections

In accordance with section 9, the Board of Trade … the order "with special reference to (a) the expense … the proposals to be submitted to Parliament and … public, and (c) any objection lodged with them

They might be induced to take the first … magnitude of the undertaking, or its effect … existing railway company We must not have … peting, on indulgent conditions, with standard railways

Under section 10, an order confirmed—with … tions—by the Board of Trade shall have effect as if … of Parliament

Under section 11, an order may contain provisions for all or any *of the following purposes* —

"(a) The incorporation, … as may be mentioned in the … What these are we shall inc… variations of the Lands Clauses Acts are required by the … cumstances of the case, the Board of Trade "must make a special *report to Parliament* on the subject", and nothing is to … any variation of the provisions of the Lands Clauses Acts with respect to the purchase and taking of land *otherwise* than by agreement

(b) The application—if and only so far as necessary—of any of the *safety* enactments mentioned in the second schedule These will be briefly referred to later on, it need only be observed here that this gives the Board of Trade freedom to narrow their requirements to what is really reasonable in each case

(c) Giving the necessary powers for constructing and working the railway

(d) Giving any railway company any power required for carrying the order into effect

(e) The constitution as a body corporate of a company to carry out the order

…

(i) Proper audit of accounts, of the managing body (unless a local authority), and the time within which the railway must be constructed

(*l*) Empowering any local authority to acquire the railway

(*m*) Any other matters ancillary to the objects of the order

Before advancing further in our summary of the sections of the Light Railway Act, it will be advisable to make a brief reference to the Clauses Acts, as defined by this Act

According to section 28 they are —

> The Lands Clauses Acts,
> The Railways Clauses Consolidation Act, 1845,
> The Railways Clauses Act, 1863, and
> The Companies Clauses Acts, 1845 to 1849

The Lands Clauses Act, 1845 [8 & 9 Vict cap 18], consolidates "in one Act certain provisions, usually inserted in Acts authorising the taking of lands for undertakings of a public nature"

It deals with the purchase of lands by agreement (sect 6–15) *or otherwise* (sect 16–80) The latter case is especially important, for while—under section 11 (*a*) of the Light Railways Act—all or any of the Clauses Acts may be incorporated in an order, subject to exceptions and variations, there must be no variations whatever of the provisions of the Lands Clauses Acts with respect to the purchase and taking of land *otherwise than by agreement*, and sections 16 to 80 of the Act of 1845 must remain unaltered, except that section 13 (1) of the Light Railways Act provides for a single arbitrator

Those sections demand the subscription of capital before compulsory powers are put in force, require notices to be duly served, provide for the settlement of disputes as to compensation, if the amount claimed do not exceed £50, by two justices, and, if it exceed £50, by arbitration or jury, at the option of the claimant, require, where more than one arbitrator is appointed, the nomination by them of an ultimate umpire, empower the Board of Trade to nominate an

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arbitration, according to the amount of the award, enable, otherwise, the promoters to summon a jury for settling any case of disputed compensation, the warrant they issue being addressed to the Sheriff, who shall summon a jury of twenty four indifferent persons, from whom a jury of twelve shall be impannelled, the Sheriff presiding at the inquiry, decide the incidence of costs of such inquiry before a jury, provide for the determination of compensation to absent parties by a surveyor appointed by two justices, but such valuation is liable to be submitted to arbitration by the absent party if he be dis-

tion is to be settled by arbitration or jury at his option, and provide for the deposit, treatment, and ultimate application of purchase money or compensation payable to parties having a partial or qualified interest in such lands, or prevented from treating, or not making title, thus, if the money payable to a party under disability amount to £200 or more, it must first be paid into the bank in the name of the Accountant General of the Court of Chancery, and if it amount to between £20 and £200 to trustees, and if it be £20 or less to parties It is impossible to do more here than indicate roughly the scope of these sections (16–80) which, quoted *in extenso*, would
but since these
purchase of land
to refer to them

We may now allude still more briefly to the remainder of the Lands Clauses Act, 1845 The conveyance of lands is dealt with (sect 81–83) Entry on lands (sect 84–92) must not, without consent, *be effected by the promoters, except for surveying, taking levels, or* setting out the line, until the purchase money has been paid or de posited Owners of intersected lands (sect 93–94) may require the promoters to purchase the same Special procedures are to be fol lowed in the conveyance of copyhold lands to the promoters (sect 95–98) in satisfaction of the rights of commoners (sect 99–107), in the purchase or redemption of interest in the case of lands in mortgage (sect 108–114), in respect to lands charged with rent service (sect. 115–118), and in the case of lands subject to leases (sect 119–122) Other matters dealt with are the limit of time for compulsory purchase (sect 123) interests omitted to be pur chased (sect 127–132) land tax and poor s rate (sect 133), ser vice of notices upon company (sect 134), tender of amends (sect 135) recovery of penalties (sect 136–149) access to Special Act (sect 150–151), non extension of the provisions of the Act to Scotland (sect 152)

Several amendments, extensions, and repeals of portions of the Act have since been made For example, the Railway Companies Act, 1867, modifies the section under which entry may be made before the amount of purchase money has been settled, and provides that, in

courts

The Railways Clauses Consolidation Act, 1845 [8 & 9 Vict cap 20], consolidates "in one Act certain provisions usually inserted in Acts authorising the making of railways, so that any of the clauses of

* Now, of course, at the New Law Courts in the Strand

this Act may, in so far as they apply to the matter dealt with, be readily incorporated in the special Act authorising the construction of any particular railway" It enacts that the power given by a special Act to construct a railway and to take lands shall be subject to the provisions and restrictions of this Act and of the Lands Clauses Consolidation Act, the scope of which has been roughly sketched above Work is not to be proceeded with until plans of all alterations authorised by Parliament have been duly deposited with the clerks of the peace, parish clerks, postmasters, etc Deviations from levels, alignment etc are definitely limited and liable to objections from neighbouring owners The interference of the railway with gas, water, and drainage is guarded Temporary occupation of roads and lands is provided for under various restrictions, and even the liability to compulsorily purchase them A railway must not cross public roads on a level unless otherwise provided by its special Act, in which case

visions are made for guarding the road approaches the limiting gradients of which are specified The company may be required to construct screens for roads where horses might be frightened by the trains Gate bridges fences, drains and other works for the accommodation of owners and occupiers of adjoining lands must be made by the company Owners may make private branch railways communicating with the railway under certain restrictions and conditions The company is debarred from mining unless they purchase the right

be liable to a greater extent than common carriers The company may alter or vary tolls but "such power of varying should not be used for the purpose of prejudicing or favouring particular parties,' and such tolls are to be ' charged equally to all persons under like circumstances The company is authorised to make and alter bye-laws regulating speed, times of arrival, the loading and unloading and the receipt and delivery of goods, etc It is enacted that engines are to consume their own smoke, and—as the use of the railway by rolling stock belonging to other owners was then contemplated and cus

must be such as comply with the

3 [26 & 27 Vict cap 92] also consolidates in one Act certain provisions frequently inserted in Acts relating to railways Part I relates to the construction of a railway Deviations within the limits and the alteration of engineering works may be authorised by the Board of Trade Trains must not be shunted at a level crossing, the company must erect a lodge at the

crossing, or the Board of Trade may, at any time, require a bridge in place of the crossing The conditions for satisfying another railway, with which a junction is to be effected under the special Act, are laid down, and the interests of navigation on tidal waters are protected Part II deals with the extension of the time limiting the power of the compulsory purchase of lands Under Part III the various matters of maintenance, use, working, rates fares, etc, which arise in working agreements between two or more companies, are restricted, the sanction of shareholders is required and the approval of the Board of Trade (but by a later Act the powers of the Board of Trade are transferred to the Railway Commissioners) Part IV determines the conditions under which a company may build, or buy, or hire, and use steam ves els Finally Part V deals with amalgamation as between two compan es

The Companies Clauses Consolidation Act, 1845 [8 & 9 Vict cap 16], consolidates "in one Act certain provisions usually inserted in Acts with respect to the constitution of companies incorporated for carrying on undertakings of a public nature" It need only be observed here that this Act provides in detail for the distribution of the capital into shares the transfer of shares the payment of calls, the borrowing of money on mortgage or bond the conversion of borrowed money into capital, the consolidation of shares into stock, the application of the capital, firstly, to payment of costs and expenses incurred in obtaining the special Act, and, secondly to carrying the purposes of the company into execution, general meetings (both ordinary half yearly and extraordinary) and the title of shareholders to vote, according to scale, either personally or by proxy, the appointment and powers of directors, their proceedings and liabilities the election or other appointment of auditors and their qualification, the accountability of officers of the company holding custody or control of monies, the keeping of accounts and the right of inspection thereof by shareholders, the making of dividends by the apportionment of profits by the directors, with reduction of the company's capital stock, and, after setting aside out of the profits, if the directors think fit, a fund for contingencies, the making of bye laws, arbitration, and access by all parties interested to the special Act, a copy of which is to be kept at the principal office, and also, in the case of a railway, canal, or other such works affecting more than one town or place, to be deposited with clerks of the peace and town clerks

Part I of the Companies Clauses Act, 1863 [26 & 27 Vict cap 118], relates to the cancellation and surrender of shares Part II, relating to additional stock, contains regulations as to the creation and issue of (*a*) new ordinary shares or new ordinary stock, and (*b*) new preference shares or new preference stock, with any fixed, fluctuating, contingent, preferential, perpetual, terminable, deferred, or other dividend or interest not exceeding the rate prescribed in the special Act, and, if no rate is prescribed, then not exceeding the rate of £5 *per cent per annum*, moreover preference shares or stock are

entitled to priority of dividends only out of the profits of each year, and, if ordinary stock or shares are at a premium, the offer of new shares or stock to existing shareholders is provided for Part III relates to debenture stock, and provides for its creation and issue up to the amount owing by the company on mortgage or bond, with fixed and perpetual preferential interest, the debenture stock to be a charge upon the undertaking prior to all shares or stock of the company, and its interest a primary charge, but holders of debenture stock have no vote Part IV relates to change of name—with continuance of powers, liabilities, and rights—of the company

The Companies Clauses Act Amendment Act, 1869 [32 & 33 Vict cap 48], removes the restriction of rate of interest on debenture stock to 4 per cent per annum, which was contained in the Act of 1863

The Companies Clauses Acts of 1888 [51 & 52 Vict cap 48] and of 1889 [52 & 53 Vict cap 37] provide for a proxy to be taken to be a shareholder

Now, under section 11 (*a*) and 12 (1) of the Light Railways Act, these clauses Acts may, with exceptions and variations, be incorporated in an order, but they are not to apply to a light railway, except so far as they are incorporated or applied by the order It must be remembered, at the same time, that sections 16 to 80 of the Lands Clauses Consolidation Act, 1845 [8 Vict cap 18], must not be subjected to any alteration

Moreover, under section 11 (*b*) and 12 (1) of the Light Railways [illegible] y, etc, mentioned in the second [illegible] far as considered necessary, be [illegible] not to apply to light railways, except so far as they are incorporated or applied by the order authorising the light railway

These enactments we will now briefly review

The first on the list is the Highways Act, 1839 [2 & 3 Vict cap 45], and the whole Act is under reference It enacts that the proprietors of a railroad shall make, maintain, and man gates where the railroad crosses any highway or statute labour road for carts or [illegible]

The 4th section requires one calendar month's notice to be given to the Board of Trade of the intended opening of a railway, and ten days' notice of its completion for the conveyance of passengers and its readiness for inspection

Section 5 exacts a penalty of £20 for each day a railway is opened without compliance with the above order, until the said notices have been duly given and expired

Under the 6th section, the Board of Trade may postpone the opening of a railway for a month, and so from month to month, as their inspector reports that the same would be attended with danger

The 9th section refers to the Highways Act, 1839 (the first enact-

ment on the schedule), and, recognising that it is generally safer, enacts that gates at level crossings be kept closed across the road, unless in certain cases the Board of Trade consider it more conducive to safety to have the gates closed across the railway

Under the 10th section a railway company is compelled to erect and maintain fences throughout the whole of the line

Third on the schedule, the whole of the Gauge of Railways Act, 1846 [9 & 10 Vict cap 57] is mentioned It establishes 4 ft 8½ in in Great Britain and 5 ft 3 in in Ireland as the standard gauge, only to be departed from in the case of certain named railways, and it enacts that the gauge of a railway shall not be hereafter altered Not only may a penalty be exacted of £10 per mile of line constructed or altered contrary to this Act for each day that it so remains, but the

t cap 119]
are named

The 19th section deals with proceedings taken against a company in case of non consumption by a locomotive of its smoke, and provides that, if the fault lies with the company or its servants and not in the design of the locomotive, the company shall be held guilty of an offence under section 114 of the Railways Clauses Consolidation Act, 1845

Section 20 requires companies to provide smoking compartments for each class of passengers, unless exempted by the Board of Trade

By section 22, every company is required, under a penalty not exceeding £10 for each case of default, to provide means of communication between the passengers and the servants of the company in charge of the train, while a passenger using the means of communication without due cause is liable to a penalty of £5

The remaining three sections deal particularly with light railways, and thus, as before mentioned, being the first reference to them by name in an Act of Parliament—sections 27, 28 and 29 may very well be quoted *in extenso* —

"27 The Board of Trade may by licence authorise a company applying for it to construct and work or to work, as a light railway, the whole or any part of a railway which the company has power to construct or work

"Before granting the licence the Board of Trade shall cause due notice of the application to be given, and shall consider all objections and representations received by them, and shall make such inquiry as they think necessary

"28 A light railway shall be constructed and worked subject to

respecting the speed of trains shall not authorise a rate of speed exceeding at any time twenty five miles an hour

"If the company or any person fails to comply with, or acts in contravention of such conditions and regulations, or directs any one so to fail or act, such company or person shall respectively be liable to a penalty for each offence not exceeding £20, and to a like penalty for every day during which the offence continues, and every such person on conviction or indictment for any offence relating to the weight of engines, carriages, or vehicles, or the speed of trains, shall be also liable to imprisonment, with or without hard labour, for any term not

de relating

r the company in manner directed with respect to bye laws by section 110 of 'The Railways Clauses Consolidation Act, 1845,' and the company shall be liable to a penalty not exceeding £5 for every day during

Railways

tends the application of sections 4 to 6 of the Regulation of Railways Acts, 1842 (see above), and the Acts amending the same, with respect to the opening of any railway, to such new works as additional lines, deviation lines, stations, junctions, and level crossings, but the Board of Trade may, in such cases, dispense with the notices required in the said Acts

The sixth item on the schedule is sections 4 and 6 of the Railway Regulation Act, 1873 [36 & 37 Vict cap 76]

Section 4 of this Act obliges a railway company to make to the Board of Trade, by the 15th February in each year, a return in specified forms —

(a) Of the cases in which a passenger line is connected with, or

or permissive block or engine in steam" syste which the different portions of the railway are worked

In default a penalty of £5 *per diem* may be exacted, unless the Board of Trade have in any case granted exemption

The 6th section is an amendment of section 6 of "The Railway Regulation Act, 1842" (see above), and empowers the Board of Trade, if it thinks fit, to postpone the opening of a railway for a further period not exceeding one month, without going to the expense of further inspections, and so on from time to time until the requisitions of the Board's officers have been complied with

Seventh on the schedule is the whole of the Railway Returns (Continuous Brakes) Act, 1878 [41 & 42 Vict cap 20], which obliges every railway company to furnish for each half year (ending 30th June and

31st December), in an appointed form, a return of the amount of passenger stock fitted and not fitted with continuous brakes, the description of brakes adopted, and whether they are instantaneous in action, self acting, universally applicable in regular use and of durable and easily maintainable materials Failures of continuous brakes must be reported in another form of return and the number of passenger trains run without continuous brakes in a third form

The eighth enactment referred to in the schedule is section 3 of the Cheap Trains Act 1883 [46 & 47 Vict cap 57] It ensures the provision of proper third class accommodation at fares not exceeding 1d. per mile, and of workmen's trains, between 6 p m and 8 p m, at reasonable fares, under the orders of the Board of Trade or—if the company appeal to them—of the Railway Commissioners, otherwise the railway may forfeit the exemption from passenger duty allowed, in respect to fares not exceeding that rate, by this same Act But, as light railways are free from passenger duty, under section 12 of the Light Railways Act, this penalty would have no force in regard to them

Ninthly, and lastly, the schedule mentions the whole of the Regulation of Railways Act, 1889 [52 & 53 Vict cap 57]

This Act, to which reference was made at the beginning of this chapter, empowers the Board of Trade to order a railway company, within a certain time,

(*a*) To adopt the block system,

(*b*) To interlock

(*c*) To use on which shall be instantaneous and guards, self applying in th 's, applicable to every vehicle—whether carrying passengers or not—in regular use in daily working and manufactured of materials durable and easily maintained and kept in order "In making any order under this section the Board of Trade shall have regard to the nature and extent of the traffic on the railway," and "shall hear any company or person whom the Board of Trade may consider entitled to be heard" To meet expenses incurred under this Act, debenture stock may be issued on a certificate of the Board of Trade

The Act contains other provisions Companies must furnish returns showing overtime of those persons in their employ whose duty involves the safety of trains or passengers Penalties are laid down for avoiding payment of fare, the offender being liable to a fine of 40s, or, in a second or subsequent case of the kind, to a fine of £20 or imprisonment for one month Every passenger ticket must have the fare printed upon its face Finally, the power to make bye laws, subject to disallowance by the Board of Trade—conferred by the Railways Clauses Consolidation Act, 1845—is extended to bye laws for maintaining order in and regulating the use of railway stations and the approaches thereto

Under section 11 (*c*) of the Light Railways Act, an order may con

tain provisions determining construction details, such as gauge, permanent way, underbridges, level crossings, etc., provisions for working the railway, dealing with station arrangements, method of traction, rolling stock, train working etc, and provisions enabling the Light Railway Company to make agreements with railway or other companies

If an agreement is [illegible]
company, the latter is [illegible]
order under section 1 [illegible]
apply for an order to construct and work a light railway as their own undertaking, they may be given the required powers under this section But they must furnish the certificate called for in the *Rules made by the Board of Trade with respect to applications to the Light Railway Commissioners for orders authorising light railways*, 27 (*l*) *

Under section 11 (*e*), the order may incorporate a company by inclusion of provisions of the Companies Clauses Acts or by the insertion of others

The Board of Trade appears, under section 11 (*g*), to have independent power to limit and regulate a council's advances or loans

In section 11 (*i*) discretionary power seems to be given, if the managing body is not a local authority, to include in the order the provisions contained in existing Acts, or to insert others, in regard to the audit of accounts

[illegible]

manner as standard railways The official and legal checks, to which railway rates and charges are subjected, have been briefly described in chapter II

New companies promoting a railway had been required to make a deposit of 5 per cent, for a railway under the Railways Facilities Act, 1864, the rate was, as we have noted, 8 per cent, and, under the Tramways Act, 1870, the rate was 4 or 5 per cent The requirement of such deposits, while schemes were still in the Bill stage, was one of the greatest obstacles to the promotion of light railway projects When once the Bill became an Act, the grievance would not exist, but, in the initial stage, it was often prohibitory The Light Railway Commissioners may now, under section 11 (*l*), require, or not require, deposits at their discretion

In speaking of tramways and the Tramway Act of 1870, it has been observed that the right of pre-emption, severely enforced by some local authorities, was one cause of the failure of that Act Section 11 (*l*) leaves it within the power of the Light Railway Com

* Appendix IX *Statutory Rules and Orders* 1896

missioners to determine, in the order, the conditions under which a local authority may acquire the railway

The effect of section 12 (2) must now be examined Subject, firstly, to the foregoing provisions of the Act, and, secondly, to any special provisions, as indicated, contained in the order, the general enactments relating to railways are to apply, and, for the purposes of these enactments and of the Clauses Acts, so far as they are applied, the Light Railway Company must be deemed a railway company and the order a special Act, and any provision thereof a special enactment, except that a light railway is not to come under the Railway Passenger Duty Act, 1842 [5 & 6 Vict cap 79], which levies the following —

' For, and in respect of, all passengers conveyed for hire upon or along any railway, a duty at and after the rate of £5 for £100 upon all sums received or charged for the hire, fare, or conveyance of all such passengers '

A number of the general enactments, relating to railways, are mentioned in the course of this consideration of the Light Railway Act, and others are quoted in Appendix X Reference may here be advised to Biggs *General Railway Acts*

Under paragraph (1) of section 13 of the Light Railways Act, where an order incorporates the Lands Clauses Acts, any matter which, under those Acts, would be determined by a jury, by arbitration, or by two justices [see remarks on section 11 (*a*)], is to be determined by a single arbitrator who is to be appointed by the parties (or, if they do not agree, by the Board of Trade) The usual 10 per cent, as compensation for compulsory purchase, etc, may or may not be added to the estimated value, but, in making his award, the arbitrator must also take into account the probable increased value of the rest of the property, remaining with the owner, due to the proposed light railway, and this would act as a set off Hitherto, the custom has been to assess the disadvantages and to ignore the advantages to the owner

Under section 13 (2) the Board of Trade may fix a scale of costs for such arbitration

award in the form of a special case for the opinion of the High Court of Justice, and to correct in an award any clerical mistake Any party to the submission to arbitration may summon witnesses or call for documents by *subpœna* The court may remit the award to the arbitrator for reconsideration or may set it aside if improperly procured The award may, by leave of the court, have effect as a judgment or order and be so enforced Subject to section 13 (2) of the Light Railways Act, the costs of the reference and award lie in the discretion of the arbitrator

Section 14 of the Light Railways Act authorises the payment to

trustees of any purchase money or compensation not exceeding £500, and provides for cases of doubtful title to, or partial interest in, the land in question This section extends the amount payable to trustees, on behalf of a partial or limited owner, from £200 (under the Lands Clauses Act, 1845) to £500

Section 15 (1) applies to any local inquiry held by the Board of Trade, Part I of the Board of Trade Arbitrations, etc, Act, 1874 [37 & 38 Vict cap 40], by which power is given to the Board of Trade to hold such inquiry by any person or persons authorised by the Board, and (as if the application for an order were for a special Act) both promoters and objectors are liable for the expenses, which will be defrayed as the Board may direct

Under section 15 (2) have been issued the "*Rules, dated September 1896, made by the Board of Trade, with respect to applications to the Light Railway Commissioners for orders authorising Light Railways*" (Statutory Rules and Orders, 1896, No 787) They are quoted in Appendix IX

According to those rules, it will be observed, in connection with section 15 (3), that a fee of £50 must be paid to the Board of Trade by the promoters before they lodge their application with the Commissioners

Unless otherwise provided, any expenses incurred by the Board of Trade will, under section 15 (4), be defrayed out of money furnished by Parliament

Section 15 (5) requires the Board of Trade to present an annual report to Parliament of proceedings taken under this Act

Section 16 of the Light Railways Act prescribes the manner in which any expenses incurred by local authorities, and allowed by the Commissi

Under com bine for ounty councils vern ment Act, 1888 [51 & 52 Vict cap 41], district councils under those of the Act of 1894 [56 & 57 Vict cap 73], and where councils cannot appoint joint committees under those Acts the provisions in apply.

18, obtain an order to hole or part of a railway or work They would, of course, have to furnish the certificate required in the *Rules made by the Board of Trade with respect to applications to the Light Railway Commissioners for orders authorising light railways*, 27 (f) (see Appendix IX)

Section 19 prescribes the conditions under which, with the consent of the Board of Agriculture, a landowner may grant land or advance money for a light railway A landowner within the meaning of the Improvement of Land Act, 1864 [27 & 28 Vict cap 114], is, "as to lands in England, the persons who shall be in the actual possession or

receipt of the rents or profits of any land, whether of freehold, copy hold, customary, or other tenure except where such person shall be a tenant for life or lives holding under a lease for life or lives not renewable, or shall be a tenant for years holding under an agreement for a lease for a term of years not renewable whereof less than twenty five years shall be unexpired at the time of making any application to the commissioners, without regard to the real amount of the interest of any person so excepted and in the case where the person in the actual possession or receipt of the rents or profits of any land shall fall within the above exceptions, then the person who for the time being shall be in the actual receipt of the rent payable by the person so excepted, unless he shall also fall within the above exceptions, shall, jointly with the person who shall be liable to the payment thereof, be deemed for the purposes of this Act to be the owner of such lands"

Section 20 provides for the conveyance of Crown lands

Section 21 guards the acquisition of commons for light railway purposes

Section 22 is framed to protect natural scenery and objects of historical interest

Junctions with existing railways will under section 23, have to be made so as to interfere as little as possible with passenger lines Passengers—as Sir James Allport said—load and unload themselves In the case of goods, however, actual connection of the light and main lines would be of the greatest value This, therefore, is to be desired, but interference with main railway passenger lines is to be avoided Under the Railway Clauses Act of 1863, the existing main line of railway may provide and work the junction and make the light railway pay for it This might cost the latter too much, and the Board of Trade may make such conditions as seem to them fair

Section 24 prescribes the manner in which an order may be amended

The definition of "Act of Parliament" in the Telegraph Act, 1878 [41 & 42 [illegible] Board of Trade [illegible]" It is now, by [illegible] lude an order au [illegible] legraph Act, it may be added, grants power to the Postmaster General to establish telegraphic lines on certain undertakings authorised by special Act of Parliament

Section 26 applies the Light Railways Act with certain modifications to Scotland It will be noticed that, while in England parish councils are not included in section 2, two or more parish councils in Scotland may, under the provisions of section 26 (2), combine where there is no district committee

Section 27 expressly excludes Ireland from the scope of the Act, it being otherwise provided for

Section 28 defines the expressions "Light Railway Company,"

"Clauses Acts" [see the remarks on section 11 (*a*)], and "Share Capital"

F [illegible] le.

T [illegible] referred to in section 12 [illegible] chapter, are given in Appendix X The reader may also consult Bigg's *General Railway Acts*, *The Light Railways Act*, 1896, by Henry Allen Stewart, and *The Light Railways Act*, 1896, by Evans Austin

CHAPTER XII

THE QUESTION OF GAUGE.

CONTENTS —Standard gauge in Europe and U S A 4 ft 8½ in —Indian gauges 5 ft 6 in metre and 2 ft 6 in —Comparative cost of these per mile, £ 200, £4 0 and £1500—Effect of of gauge on working expenses—M gauges in India—Break of gauge a gauge on main line routes in India
pendent on physical he narrow gauge— auge generally re be eliminated from lia—Sir John Wolfe

Standard Gauge of Great Britain etc —The 4 ft 8½ in gauge has been adopted as the standard for normal railways in Great Britain and most European countries It was originally chosen because it happened to be that of the road wagons in the north of England which first ran on railways

of trains depended on the the centre of gravity of a rails Brunel introduced a broader gauge of 7 ft, which made a splendid road—bridge rails on longitudinals—and existed on the Great Western Railway and its connections until 1892

There is no practical reason for departing from the 4 ft 8½ in standard—which is that of Great Britain, the United States, and, excepting Russia and Scandinavia, of continental Europe—and it is to be regretted that Irish broad gauge lines are committed to the 5 ft 3 in and Indian to the 5 ft 6 in standard Our light railways may be as light as can be but, if they are of the standard 4 ft 8½ in

of overlapping conditions

Indian Gauges —In India three gauges—the 5 ft. 6 in, the metre and the 2 ft 6 in —have been freely tried It furnishes us, therefore,

with the best examples to assist us in determining the effect of gauge We may take our figures from the *Administration Report on the Railways of India* for 1895–96

The average cost per mile of railway open is Rx 16,273, or (assuming, for the purposes of this discussion, that 10 rupees are equal to 12 shillings), £9764 for the 5 ft 6 in gauge, Rx 7214 or £4328 for the metre gauge and Rx 3342 or £2005 for the special smaller gauges

Investors or promoters, however, would scarcely accept, for purposes of rough comparative estimate, averages of *all* the railways on each gauge The older the line—and the broad gauge railways

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or 5 ft 6 in gauge, Rx 7000 or £4200 for the metre gauge, and Rx 3333 or £2000 for the smaller special gauges, we should prefer figures based on "modern instances,' and regard Rx 12,000 or £7200 as roughly representing the cost of a 5 ft 6 in railway per mile, Rx 7500 or £4500 as that of a metre gauge, and Rx 3000 or £1800 as that of a 2 ft 6 in gauge line All the lines averaged would give us ratios of 16 7 3 very nearly, modern instances correct the ratios to 16 10 4, or 8 5 2 These figures are suggested as fairly representative of the comparative cost of a railway in India according as it is built on the 5 ft 6 in the metre, or the 2 ft 6 in gauge

It must not be supposed, however, that gauge is the only—or even the most important—factor upon which the cost depends We may, perhaps, trace its influence on the cost most conveniently by examin

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Malwa (metre), and the Cooch Behar (2 ft 6 in) Railways

On the Bengal Nagpur Railway (5 ft 6 in. gauge) the permanent way consists of 75 lb flat footed steel rails on steel sleepers, ballasted throughout with good stone The line generally is unfenced, except at important stations The mileage open was 861 miles On the main line exceptionally heavy bridging of tributaries of the Mahanadi river occurs for 220 miles On the Umaria Bilaspur section is a *great deal of heavy work in bank and cutting a tunnel 1200 ft* long, etc Practically, the ruling gradient is 1 in 100, and the minimum radius of curves 1000 ft For further details of rolling stock, traffic, earnings, etc , see the tables in the Appendices

On the Indian Midland Railway (standard gauge), the permanent-way consists of 80 lb flat-footed steel rails on oval pot cast-iron sleepers The line is fenced throughout The mileage open was 677 miles There is only one gradient so steep as 1 in 100, and there are no

curves with a radius of less than 1000 feet There is a good deal of

Railway (metre gauge) Tirhoot
40 lb iron (being replaced by
50 lb steel) or 41¼ lb steel rails on wooden or on cast iron plate sleepers. The line is fenced and ballasted The country is easy On the Sonepore Ajodhya section the country is subject to inundation, and this has involved heavy banking Bridging the Rapti and crossing the drainage of the Gunduk and Gogra rivers have been expensive The grades and curves are easy There is a considerable mileage of unfenced branches

On the Rajputana Malwa Railway (metre gauge), the original 36 lb and 40 lb rails have already been largely replaced by 41¼ lb and 50 lb steel rails The standard of construction varies considerably over a total open mileage of 1674, but is generally an exceptionally high one As a rule the gradients and curves are easy The Rajputana section includes a good deal of bridging, especially the bridge over the Jumna at Agra There are heavy works on the Malwa section, including the Nerbudda bridge, tunnels, viaducts, etc on the Holkar railway A great deal of the line is unfenced

The Cooch Behar State Railway (2 ft 6 in gauge) runs through an easy country, on an embankment 12 ft wide The permanent way consists of 25 lb flat footed steel rails, on pyngado sleepers in sand ballast The bridges are built with metre gauge girders The line is unfenced The curves and gradients are easy, but the quantity of earthwork is increased by a wide formation and embanking the line well above a country liable to inundation

Relation between Gauge and Cost.—We may now endeavour to sec

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cedure, and, although the price paid in accordance with the assessment of the civil authorities is very rightly a liberal one, it is not excessive Indeed, so cheap is land that embankments are seldom made up of

track, sufficient land has been taken up to admit of another track being laid if necessary hereafter

The cost of earthwork to formation is the next item. It is one that is very largely dependent on grade and very little on gauge The steeper the ruling gradient, the shorter and more direct will be the practicable route in a hilly country, and the sharper the limiting curve, the larger the freedom and flexibility of adjustment that will be possible Now these are two of the advantages claimed by the

DETAILS OF MILEAGE COST OF INDIAN RAILWAYS OF DIFFERENT GAUGES, FROM THE ADMINISTRATION REPORT OF 1895 96

Main Head.	Bengal Nagpur	Indian Midland	Bengal and North Western	Rajputana Malwa	Cooch Behar	Sub heads included in Main Heads
Gauge	5 ft 6 in Rx	5 ft 6 in Rx.	Metre Rx	Metre. Rx	2ft 6in Rx	
Preliminary Expenses	174	134	54	156	44	Survey expenses plant establishment
Land	69	73	254	59	45	
Formation	1609 }	}	{ 314	471	373	Earth works, tunnels
Bridge Work	2120 }	4448	{ 1191	1400	269	Large bridges minor bridges
Fencing etc	41 }	}	{ 264	103	4	Fencing road crossings mile and gradient posts
Electric Telegraph	}	}	{	1		
Ballast and Permanent Way	3516	4057	2325	2249	1369*	*Unballasted
Stations and Buildings	725	747	897	1002	140	Stations and offices workshops store buildings staff quarters station machinery
Plant	19	56	170	176	32	Engineering locomotive carriage and wagon plant station and office furniture
Ferries etc			161			Ferries and floating bridges
Rolling stock	1743	851	666	1175	346	Locomotive carriage and wagon
General Charges	669	559	401	536	236	Direction engineering, stores, audit and account medical and sanitation
Loss by Exchange	76	37	207			
Total	10 934	10 962	6904	7328	2858	

advocates of narrow gauge lines and they offer, especially in a country which presents exceptional engineering difficulties, considerable opportunities for reducing the cost of earth work and other items of construction If however, these difficulties occur at one or two critical points only and are not characteristic of the line generally, the economy gained in alignment and grading will not necessarily justify the adoption of a narrow gauge

It must be conceded that not as a necessary consequence of adopting a very small gauge but as a matter of fact, the haulage of the same amount of paying load on a line of light traffic will generally be weighted with less dead load on the smaller guage, and steeper gradients, therefore, will be practicable at a pinch

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Location claims an advantage in respect of adaptation to sharp curves *in favour of broad gauge* On the *Manhattan Elevated Railway in* New York, curves of 88½ feet radius are not too sharp for the stock

Much sharper curves might be negotiated both on the 5 ft 6 in and metre gauges, than those prescribed as the minima in the standard dimensions laid down by the Government of India so that no special value need be attached to the quotations here made As a matter of fact, however, a radius of 1146 ft is the absolute, and of 1910 ft the preferred minimum, *in ordinary country* for curves on the 5 ft 6 in gauge, on the metre gauge, 716 ft is the absolute, and 1146 ft is the preferred minimum, and on the 2 ft 6 in. gauge 238 ft is the minimum, so that the Government of India limits are considerably in favour of the smaller gauge *In difficult country*, where economy is most important a curve of so small a radius as 573 ft is permitted on the 5 ft 6 in gauge, as against 358 ft on the metre gauge

Width of formation offers a direct and obvious, but not a very important, advantage to the adoption of a narrow gauge The saving in earth work is confined to the vertical strip covered by the difference in width of formation, this difference is 4 ft 6 in. in cutting, and only 2 ft 6 in in embankment, as between the 5 ft 6 in and metre gauges, and it leaves untouched the section covered by the slopes, that portion which would remain if the width of formation were *nil* Even on the Cooch Behar 2 ft 6 in gauge line the banks are 12 ft wide, the minimum is 10 ft on the 2 ft 6 in gauge, 14 ft on the metre gauge, and 16 ft 6 in on the 5 ft 6 in gauge In a country where earth work is cheap, the difference in gauge offers very little opportunity for economy

The quantity of earth work in bank or cutting covered by the slo
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height of embankment or depth of cutting increases, it is, in fact, least important where it is most desirable, in heavy bank or cutting

Whatever the economy effected by choice of a narrower gauge and formation may be, it is often greatly discounted by building wagons which are almost as wide as those of standard gauge With slow speeds and small wheels the over hang may be increased and a reduction of gauge need not mean a corresponding reduction in capacity, but, again, we cannot have wider stock without a wider formation, and thus such economy in earth work as a narrow gauge might claim very nearly disappears

Double lines are scar
cussion, but it may be
between tracks, centre

street Then the space occupied by the light railway and left to ordinary road traffic, as well as the width of track to be paved and maintained by the former, depend very directly upon the gauge adopted, every foot of room, every inch is precious, and, if town councillors are thus forced to insist upon a smaller gauge for a light railway invading their town, they are more justified than when they break the gauge, because wagons and trucks might otherwise cross a street or two, startling their sleepy traffic, and spoiling the beauty of their shops and villas

Much of the cost of bridge-work is not only dependent upon physical difficulties and independent of gauge, but actually independent of the moving loads also

The longer the span of a bridge, the less important becomes the

is taken over the bridge Thus, on the one hand, we ventured for
broad gauge trains very slowly and
for the metre gauge, on the other
isable to erect metre gauge girders, ready for future developments, on a 2 ft 6 in gauge railway in Bengal As a matter of fact, on the railway referred to, the embankments and the girders are capable of taking a metre gauge line to morrow With light loads and slow speeds, therefore, there is not very much economy secured by choosing a narrow gauge, and such economy as is possible tends to vanish as the span of the girders increases While this is true of girder work, it is equally obvious that the cost of wing walls depends in no way on the gauge, and that the saving on width of abutment and width of piers is not very

important, especially where the foundations which carry the piers and abutments are deep and costly, and protective works—a matter absolutely independent of gauge—are on a large scale A study of the cost and particulars of some of the large railway bridges in India* will show at once that, while the cost per lineal foot varies very much, the gauge is the most insignificant factor of the many which affect the cost

For comparing the cost of 5 ft 6 in and metre-gauge bridges and culverts of smaller span we have ample data in the *Bridge and Culvert Tables* worked out by Mr L H Stone, M Inst C E, the present chief engineer of the East Indian Railway, but our quotations must necessarily be brief, and only a few of the more important items can be compared

Girder Bridges	Height of Bank	Two Abutments and One Pier		One Span	Gauge
		Concrete	Masonry	Girders	
	Ft	Cub ft	Cub ft	Tons	
6 ft span	10	1,579	4,529	0 74	5 ft 6 in
,, ,,	,,	1 395	3 850	0 48	metre
12 ft span,	10	1 838	5,159	1 44	5 ft 6 in
,, ,,	,,	1,634	4,402	1 15	metre.
,, ,,	20	3,605	15,644	1 44	5 ft 6 in
,, ,,	,,	3 321	13,982	1 15	metre
20 ft span	10	2,156	6 055	3 14	5 ft 6 in
,, ,,	,,	1 911	5,137	2 37	metre
,, ,,	20	4,054	17,457	3 14	5 ft 6 in
,, ,,	,,	3,728	15,598	2 37	metre
,, ,,	30	6 559	38,251	3 14	5 ft 6 in
,, ,,	,,	6 151	35,007	2 37	metre
40 ft span,	20	4,461	21 616	9 65	5 ft. 6 in
,, ,,	,,	4,121	19,318	7 66	metre
,, ,,	40	10,259	81,430	9 65	5 ft 6 in
,, ,,	,,	9,759	75,982	7 66	metre

From the table here compiled we see that, for girder bridges of small span, the adoption of the smaller gauge does not greatly reduce the quantities, and that the reduction is comparatively less as the height of bank and span of girders increase Thus, taking the top

* Pp 50 55, *Administration Report on the Railways in India* for 1895-96, Part II.

and bottom figures we find that, while the concrete is 13 per cent more for a 5 ft 6 in girder bridge of 6 ft span, it is only 5 per cent more for a 5 ft 6 in girder bridge of 40 ft span, than for metre
asonry, an
per cent
per cent
heavier on the 5 ft 6 in gauge
is only 26 per cent heavier

In the same way, a refere
culverts, the slopes of the embankment being 2 to 1, would show us at once that the quantities for a culvert on the 5 ft 6 in gauge, when the height of bank is h ft, are precisely the same as the quantities for a culvert on the metre gauge, when the height of bank is $h+1$ ft Without going into details, therefore, it is evident that, while in an embankment 5 ft high, the difference is 20 per cent, in an embankment 10 ft high it is only 10 per cent, in an embankment 40 ft high only $2\frac{1}{2}$ per cent and so on Here, again, the saving in expenditure to gauge diminishes as the work becomes heavier, diminishes, in fact, exactly where economy is most valuable

In open top and flat-top culverts of 2 ft span, the percentage of saving in a narrow gauge is much higher than for water ways of larger span

Under the main head of bridge work we must finally admit that difference in cost depends mainly upon physical difficulties, much less upon gauge

In ballasting, a good deal of difference is made by the gauge That is obvious In the list of standard dimensions laid down by the Government of India, we find that the absolute minimum width of ballast at level of foot of rail is 10 ft on the 5 ft 6 in gauge and 7 ft on the metre—a difference of 3 ft, while the preferred minima are respectively 11 ft and $7\frac{1}{2}$ ft, a difference of $3\frac{1}{2}$ ft Moreover, even when the same minimum depth of ballast below sleepers is adopted (as in cuttings in soft soil or on banks), the shallower sleeper of the narrow gauge will materially reduce the total depth of ballast required So that both in width and depth the reduction in the section of ballast is important

In permanent-way the difference in cost is largely independent of the gauge The most important factor is the weight of the rail, and that cannot be expressed in terms of the gauge Generally and practically it is determined by the maximum weight on a pair of
ave at the
Moreover,
erviceable
wals, and
these may often be cheaper and stronger than new rails of lighter section The use of second hand sleepers, however, is not to be advised, new sleepers are more economical

The maximum weight on a pair of wheels is 15 tons on the 5 ft.

6 in gauge, 8 tons on the metre gauge and 6 tons on the 2 ft 6 in gauge. The maximum gross weight of engine and tender together permitted on the 5 ft 6 in gauge is 56 tons, and on the metre gauge 46 tons. The weight per yard of rail adopted to take these loads on each of the railways compared in the table has been stated above

The absolute saving in quantity of sleeper wood may be measured by the ratio of that required on the 5 ft 6 in to that required on the metre gauge—9 to 4

A glance at price-lists will show us that the ultimate economy is reached with the 2 ft gauge, for the difference in cost per yard of portable railway of 16, 20, 24 or 30 inches gauge is merely a matter of pence

Stations and buildings are purely a question of accommodation required How little gauge has to do with expenditure under this main head is indicated by the amounts for the two metre gauge railways being larger than those for the two standard gauge lines On the metre gauge—and much more on lines of less gauge—platforms may be altogether dispensed with So, in the case of light railways of 4 ft 8½ in., or 5 ft 6 in gauge they are not absolutely necessary

Platforms and walls of liberal and uniform height are most particu

must be able to take it for granted that, whenever he gets out he can step on to a platform of exactly the same height that he is accustomed to, he must not be taken by surprise

To light railways these considerations scarcely apply The choice seems to lie between a platform of reasonable and convenient height and no platform wall at all, the surface being simply consolidated flush with the level of the rail Most of the cost of a platform wall is belo
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5 ft 6 in, metre, and 2 ft 6 in gauges respectively, but the preferred minima—to allow not only for very wide metre guage stock but for a possible increase of gauge and consequent expansion in the future—are 15 ft 6 in and 14 ft 6 in on the standard and metre gauges Sidings fall under the head of "ballast and permanent way," and the

Points and crossings, water columns, turntables, etc, come under the subhead of "station machinery" and main head of "stations and buildings" The minimum diameter of an engine turntable is 50 ft on the 5 ft 6 in gauge, and not more than 36 feet on the metre gauge, that of a carriage or wagon turntable is 18 feet on the 5 ft 6 in gauge, and only 14 feet on the metre gauge These will, however, be required at termini only, and, if land be available, triangles, the cost of which scarcely depends on gauge, may be substituted

In constructing an engine running shed, the Government of India prescribe, as the absolute minimum distances between tracks, 10 ft 6 in on the metre gauge and 14 ft on the 5 ft 6 in gauge, but they would prefer a distance of 17 feet on both gauges, and such a preference practically ensures its adoption

On the subject of "rolling stock," the next item for comparison, it may be said that, absolutely apart from gauge, the expenditure on rolling stock must depend upon the amount, the nature, and the conditions of the traffic dealt with The Bengal Nagpur heads the list, the metre gauge Rajputana Malwa Railway comes next, the Indian Midland does with half the expenditure of the Bengal Nagpur, the metre gauge Bengal & North Western follows it very nearly, and the Cooch Behar stock costs least of all

Between the two 5 ft 6 in gauge lines, the Bengal Nagpur and Indian Midland, the differences in capital outlay, mileage, working expenses, goods traffic in general merchandise, train mileage, and

way, as compared with 519,437 tons on the Bengal Nagpur, it is not surprising that the number of goods vehicles required on the latter is in the ratio of five to three required on the former

locomotives, two and three times as many passenger and goods vehicles, and its expenditure of Rx 1175 per mile on rolling stock is justified by its traffic, and is absolutely independent of its gauge

The maximum width over open doors is 13 ft 3 in for passenger, and 14 ft for goods vehicles on the 5 ft 6 in gauge, 12 ft 6 in for passenger and goods vehicles on the metre gauge, and the maximum width of stock over all (not necessarily the same thing, it will be noticed), 7 ft 6 in on the 2 ft 6 in gauge The maximum height above rail level, the minimum accommodation and the maximum

weight on a pair of wheels are also given in the table of standard dimensions in Chapter XIV

In regard to the main heads of 'plant ferries' "general charges," and "loss by exchange," no comparison need be made

The proportion of working expenses to gross earnings is 51 per cent on the Bengal Nagpur 58 on the Indian Midland 42 on the Bengal & North Western 75 on the Rajputana Malwa, and 64 on the Cooch Behar Railway This is entirely a matter of traffic and a high percentage of expenses in earnings is no more against the narrow gauge than a great many other statistics advanced by its extreme advocates are in its favour purely as a question of gauge

As a result of our comparison of typical Indian Railways, it is suggested that the actual cost may be roughly represented by Rx 12,000 or £7[illegible]0 on the 5 ft 6 in Rx 7[illegible]00 or £4500 on the metre, and Rx 3000 or £1800 on the 2 ft 6 in gauge The influence of gauge on each item of expenditure has been generally indicated

It will be interesting to quote a similar comparison—in lump sum only, not in detail—between French railways on the 4 ft. 8½ in, metre, and 2 ft gauges

M A de Lapparent * takes £6437 per mile (100 000f per kilom) as th[illegible] £3862 per mile (60,000f [illegible] auge line, if fixed signals, [illegible] of 25 to 30 millimetres allowed, and sheds for stations (and it will be noticed that this stipulation brings the metre gauge figures under light railway conditions which do not directly depend upon the gauge), and £1287 per mile (20,000f per kilom) as that of a 2 ft gauge portable railway on the Decauville or "ladder" system

The locomotives on the metre gauge referred to by him are very light—15 to 33½ tons,—and, on the 2 ft gauge 9½ tons empty and 12 tons in working order The rails are correspondingly light, less than 20 lbs per yard on the 2 ft gauge The passenger carriages are 5 ft 7 in wide

Battle of the Gauges in India —The experience of India in the matter of gauges illustrates the inconvenience of having adopted a standard wider than 4 ft 8½ in The choice of the 5 ft 6 in gauge —for no other reason apparently, than its being a compromise between the English 7 ft and 4 ft 8½ in gauges—was made in accordance with the advice of an engineer specially summoned from England This was the first mistake Were the 4 ft 8½ in gauge the standard, locomotive and other rolling stock could be imported from the mother country at a crisis, and the advantage of this, from a military and political point of view, must be enormous

Railway development in India was later on checked by the cost of an unnecessarily broad gauge for the purposes of lines of poor traffic Eminent engineers advocated a 3 ft 6 in gauge and estimated the difference in cost—as between that and the 5 ft 6 in gauge—at from £784

* *Le Siècle du Fer*, by A de Lapparent, Paris.

to £984 per mile, while Mr Thornton,* adding capitalised savings, made it £1000 The drawbacks of transhipment were discounted by Mr Grierson The disadvantages of break of gauge, from a strategic point of view, were pointed out by Sir W P. Andrew, and the additional cost and inconvenience of different stock by Mr Bidder Mr (now Sir Alexander) Rendel wanted a smaller gauge, 2 ft 9 in, and a 36 lb rail, and had the 4 ft 8½ in gauge been the standard, this—or, better still, the 2ft 6 in—should have been the only alternative The general tendency towards the decimal system of weights and measures, which was prevalent, induced Lord Mayo to decide finally on the metre gauge

At that time Mr (now Sir Guilford) Molesworth was consulting engineer for railways to the Government of India (1872–89), and his

[illegible] for example, expert advice would point out that excessive dead load is chiefly d[illegible]
rolling stock
spent in dense c[illegible]
gauge was most
As a matter of fact the capacity of the metre gauge carriages and

and prevented interchange of stock, but transhipment involved expense, divided responsibility, delays, demurrage, opportunities for

heavy expense by new works on various alterations of alignment

The commercial objections to transhipment are less serious There must be a direct addition to capital cost to provide special sidings,

* Thornton on "Gauge" *Min Proc Inst C.E*, vol xxxv, 1872–73

Commissioners) estimated the cost at 2s a ton * Mr Grierson, after observing that the cost, damage, and delay due to transhipment on break of gauge had been very much exaggerated, and pointing out that the greatest inconvenience was felt with mineral and bulky or heavy traffic, considered that its cost was not more than 5d or 6d a ton, being less than that involved in the transfer of goods from warehouse to cart, from cart to railway wagon, and delivery at destination † Mr Bryce ‡ calculates the cost at 6d a ton M Auguste Moreau is sanguine enough to say that the working expenses, due to break of gauge, may be reduced to ½d per ton, if proper arrangements are made § Mr Money ‖ considers the cost equivalent to a carriage of 6 miles MM Sartiaux and Banderali estimate it at 2d to 3d, or exceptionally 4d per ton ¶ The Clearing House allowance for transhipment, in the days of the G W R broad gauge, was 20 miles On the Eastern Bengal State Railway the transhipment from broad gauge wagon to river flat, across the Ganges, and from river-flat to metre gauge wagon may be estimated with reference to 250,000 tons and 250 000 passengers, and a total cost for working the ferry of Rx 40,000 or £24,000 The cost, therefore, may be put down at 11d per ton or per passenger, and this includes (over and above the expenses that would be incurred if the transhipment were directly from wagon of one gauge to wagon of another) a second handling and checking of the goods, the cost of working and maintaining the steamers and flats, the interest on the capital expended on them, the cost of ripping up and relaying the sidings as one point or another is workable, the varying length of the train journey, etc Our experience, accordingly, would support Mr Grierson's figure of 5d a ton, as being an ample estimate of the probable cost of transhipment due to break of gauge only Mr R C Rapier, chairman of the Southwold Railway (narrow gauge), ingeniously claims as an advantage of adopting the smaller gauge on feeder lines, the allotment of 9d per ton for transhipment to the narrow gauge line, because this more than covers the cost

Even the disadvantage of delay may be greatly discounted by good organisation M Auguste Moreau asserts not only that bulk has to be broken in any case
as ¾ths of all goods, even ii
His remarks must, however
When he argues that the tr
is least troublesome, he directly contradicts Mr Grierson's evidence in regard to this traffic, and ignores the risk, the damage, and the

* Transport, vol x Jan 1895

st C E, vol xxxv, 1872–73

E, vol lxxxi. Pt 371–5 1885
96

wastage to which it is exposed It must not be forgotten, however, that transhipment—independently of break of gauge and quite in the ordinary course of service—has often to be faced in the case of luggage and mixed vans, and that other than complete wagon loads have to be opened, divided and rearranged

The evils of transhipment are, of course, more especially felt in relation to goods traffic Passengers—if Sir James Allport's remark may once more be quoted—load and unload themselves

Many suggestions have been put forward to obviate the delay, the cost, and the inconvenience caused by break of gauge One is to lift the narrow gauge bodies off their wheels and to load them up on the broad gauge truck an addition of special stock which is not likely to find much favour Herr Ziffer * on a system of four rail, would interpose a special brake van having normal side buffers and a narrow gauge lower central buffer as well, between the wagons of both gauges and thus link them up to be hauled by a locomotive on either gauge wherever required for shunting transhipping and loading purposes, but the combined movement of standard and narrow gauge stock on four rails is very seldom required An English engineer Mr Everard R Calthrop, the advocate of 2 ft 6 in gauge light railways, has designed a special transportation car on the narrow gauge to carry a broad gauge wagon, which deserves attention It is a singular conception, however, to tackle the difficulty of transhipment by making a transportation car, running on a *light railway* of narrow gauge carry a loaded standard gauge wagon The car consists of a low hung open frame, between which rise the wheels running on the 2 ft 6 in gauge and to the sides of which are fitted two troughs on carriers placed low down on either side along the whole length On to these troughs the broad gauge wagon is run, and the difference between the gauges is so great that its wheels easily straddle the frame and wheels of the 2 ft 6 in car Loaded lorrys and farmers' wagons too may thus be transported over the

were

y was

the metre gauge acknowledged to be equal to the requirements of ordinary traffic, but it was as capable as English rolling stock of carrying all sorts of military equipment artillery, and siege guns The metre gauge vehicles were 6½ feet wide, as compared with a width of 8 ft on the broad gauge Equally slow speeds would enable the latter vehicles to be made as wide as 11 ft

It was at the same time recognised that statistics of the performance of engines and vehicles purposely designed for slow speeds could not fairly be contrasted with those designed for high speeds, and that comparisons could not be drawn between stock built for dense heavy freight or mineral loads and stock built for light or average

* *Die Einmündung der Schmalspurigen Steiermärkischen Landesbahnen etc* Wien 1894

freights In heavy mineral traffic the smaller gauge might have the advantage, but, for the carriage of light and bulky agricultural produce—the principal freight in India—the broader gauge was the more suitable

Again, with no heavier rail than that required on the metre gauge, the 5 ft. 6 in ga
wagon stock th
signments conse
And the cost of
The result of

other paying railways
was so strained by the
increase of traffic that it was proposed to double the road or re lay the track on the 5 ft 6 in gauge In cost there was little difference between these alternatives The development of other centres has since relieved it of traffic which might overtax a metre gauge single line

The discussion on gauge was again revived in India a few years ago, but rather with reference to feeder and branch railways than to main line routes

Colonel Conway Gordon, R E, Director of the North Western Railway, in 1886, pressed for the promotion of light traffic feeder lines on the 5 ft 6 in gauge to tap the ever increasing areas of land opened up for wheat cultivation by the splendid efforts of the irrigation engineers in the Punjab At the same time, in the Bombay Presidency, branches on the metre gauge were constructed as feeders to the Rajputana Malwa Railway In Bengal the tendency has been to develop light railways on the 2 ft 6 in gauge and in this Presidency a change of gauge may very well be made where vast and wandering rivers in any case break the continuity of railway communication

The drift of official opinion six or seven years ago was in favour of adopting the broad gauge for all future railways, unless there were special reasons against it At the same time, experience of military difficulties, due to transhipment as well as the influence of powerful railway companies interested enforced the advisability of completing missing links in through communication on the metre gauge, but railways adopting this gauge must comply with standard dimensions which would be suitable for the 5 ft 6 in gauge also The conversion of existing lines to broad gauge is subordinated to the construction of new lines The gauge of feeder lines should preferably be the same as that of the trunk line they are intended to feed, and thus
naturally
consider
uge whe
it was desired l or railways in connection with frontier expeditior
the Military Department in India last year decided to adopt the 2 f
gauge, rapid construction being of the first importance, and the li

and stock being able to carry all they required The writer ventures to suggest that nothing less than 2 ft 6 in should have been adopted, and that the Public Works Department should not perpetuate the blunder by declaring—as they are said to have done*—a decided preference for a 2 ft gauge to be adopted in future on narrow gauge feeder lines generally

Alleged advantages of Narrow Gauge Stock—M Auguste Moreau's demonstration of the advantages of narrow gauge railways—in the *Memoires de la Societe des Ingenieurs Civils*, 1884, p 537†—deserves consideration Comparing 4 ft 8½ in and metre gauge

would be as the squares of the gauges, giving a ratio of 1 to 2 Thus a metre gauge wagon, weighing one third as much as, could carry one half the load of a 4 ft 8½ in wagon On these assumptions, therefore, *the ratio of dead weight to paying load on the metre gauge is only* two thirds of that on the 4 ft 8½ in gauge In practice, M Moreau admits, these ratios so favourable to the smaller gauge, do not obtain, and he proposes 7 10 as the practical ratio instead of 2 3, the theoretical ratio

Further, his view is that metre gauge stock might be as wide as 9 ft 2 in But, on the same conditions, we may widen broad gauge stock in the same proportion That for local traffic in small consignments small stock, on whatever gauge, is most convenient has been admitted M Moreau does not dispute that bogie stock on the normal gauge will negotiate sharp curves in rough country, but he asserts that the ratio of dead to paying weight is—with full carriages—increased to 8 1 on the normal gauge, as compared with 3 1 on the metre gauge The value of passenger stock, however, is rather one of facilities than one of tare—bogie stock is, as a rule, for passengers—and any passenger will give his opinion in favour of broad gauge for space, convenience, and facilities

In regard to break of gauge, M Moreau reviews the objections, and disposes of them as follows —Working expenses of transhipment may, if proper arrangements be made, be reduced to ½d per ton, on which point evidence has been given above Delay is of little importance, as a day is usually lost in passing a truck from one system to another
tolerated
or India
and other minerals is of little import, the experience of most of us

* *Indian Engineering* Sept. 17, 1898
† *Min Proc Inst C E* vol lxxxi, 1885, pp 371-75

three fourths of all merchandise arriving in full wagons. If the circulation of rolling stock on all lines of the same gauge is so imperfect as M Moreau indicates, this would appear to be one of those things which they do not manage quite so well in France as in England, or even in India

The tare, ca [illegible] upon the nature of [illegible] speed permissible, th[illegible] hang, etc, than upon the gauge

"Consequent," says one advocate of narrow gauge, "upon the *much lower speed of trains upon the 2 ft 6 in gauge, shocks and* vibrations are so much less violent, that the diminution of wear and tear is very marked, and it is, therefore, the practice to build under frames, proportionately very much lighter than on the standard gauge"

Quite so, "consequent upon the much lower speed of trains upon the 2 ft 6 in gauge," we can do this and many other things, but surely we can reduce the speed without narrowing the gauge On this point the late Lieut Gen Sir George Chesney, R E, when on the Indian Council, once observed with quiet humour —"It is now generally admitted that the old notion of a broad gauge railway being more expensive to [illegible]
and, for my own part, I [illegible]
just as cheaply as the [illegible]
regulated, for the most part, by the rate of speed to be used on it, and some stress is laid on the practical difficulty of maintaining a low rate of speed on a broad gauge line *Many of our railways, however, have overcome this difficulty so far with remarkable success*"

As, whenever this question is discussed, comparisons are made between the tare, dimensions, and load of rolling stock on one gauge and another, a few more remarks on this subject will be inserted here

On English railways, goods vehicles capable of carrying 8 tons may not carry a useful load, on the average, of more than 1 ton The ultimate capacity has little or nothing to do with the average load A goods vehicle must be capable of carrying a reasonable maximum load, but full loads are far less important than rapid service If a provincial tradesman wires to a London wholesale house an order for certain goods to day, he expects to get them to morrow morning

In the United States full loads, as well as rapid service, are im[illegible]

[illegible]

demands a steady service, full [illegible] the carrying power of the railway to the Eastern Bengal strains the utmost, not only by its quantity, but also by the variations of the market

On lines of poor traffic, economy and full loads are the first necessity, rapid service a minor consideration

The standard covered goods steel wagons on the Eastern Bengal

State Railway, 5 ft 6 in gauge, are 9 ft wide and 7 ft 10 in high inside, the sectional area thus being 70 5 sq ft, their tare weight is 7 tons 10 cwt and they carry 16 tons 10 cwt Those on the metre gauge are 6 ft 7 in wide and 7 ft 7 in high, have a sectional area of 47 7 sq ft tare 4 tons 17 cwt, and carry 9 tons 3 cwt The standard covered goods bogie wagons for the Barsi Light Railway, 2 ft 6 in gauge are 7 ft wide and 6 ft 6 in high inside, give a sectional area of 45 5 sq ft they tare 5 tons 18 cwts, and their load is 14 tons 2 cwts The maximum weight on a pair of wheels permitted by the Government of India in the case of goods stock is 12 tons on the 5 ft 6 in gauge 7 tons on the metre gauge, and 5 tons (for all stock) on the Barsi Light Railway of 2 ft 6 in gauge

On a light railway—Caen to Dives and Luc sur Mer—in Normandy, constructed by the "Decauville" Company on a 2 ft gauge, are goods wagons of two types a four wheeler to carry about 5 tons, and a bogie wagon carrying a standard gauge load of 10 tons—these weigh only about 3¼ tons each * The ultimate economy in cost of rolling stock is certainly reached on the 2 ft gauge, just as we found in the case of permanent way The perusal of a portable railway catalogue shows us that the difference in price between one 24 inches, is may cover a

gauge only, goods, con th, stability, speed, etc—that *ex parte* arguments in proof of the advantages of one gauge or another must be received with the utmost caution

The late Mr A M Wellington† made the following remarks on this subject —

ion that there is Any reputable he same weight and power for either gauge, which will traverse the same curves, for the same price The standard gauge engine, in fact, will or can have

be exactly the same, and the trifling loss from the extra width of trucks,‡ if it were worth discussing at all may be fully made up by a slight increase in the weight and capacity of the car body, while car bodies of the ordinary size and capacity can go safely over any structure or track which will carry a light locomotive—whether

* ... 1896

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‡ ... of

cour

standard gauge or narrow gauge—and carry as large a paying load as is customary in narrow gauge cars"

Standard Gauge generally advisable in England—It would generally be a mistake in England, in cases where goods traffic is the main consideration, to establish a light railway with a short lead on the narrow gauge and incur for all goods the expense and inconvenience of transhipment After all, English standard gauge stock is not too heavy for draught by horses or pushing by hand, and there should be no difficulty in laying light rails to broad gauge right into a farmer s fields, and shifting the lines as required If the trucks are to run direct from the fields to the market, our light railways in England must be on the 4 ft 8½ in gauge Locomotives need not run on the farm sidings, but the free circula

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can be laid down All that need be enforced here, in regard to

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for that, we may take on standard goods stock with special light locomotives and, at the worst, we can employ horses to draw, or we can push by hand, main line goods stock on unballasted sidings extended into the fields as may be necessary from time to time

has been fought and finished The question has not even died hard, for it is very much alive at the present day, and will assert itself in the consideration of every light-railway project

Final Remarks on Indian and English Gauges—In regard to India, Mr I Wolley Dod has concisely summarized the matter After observing that the broad gauge even with a very moderate amount of traffic, works more economically, while the arguments in favour of one standard carry considerable weight, he goes on to say *—

"The real argument of the opponents of introducing a gauge narrower than the standard in any country is not that a line of 2 ft 6 in or 3 ft gauge, laid with rails of 20 to 30 lbs, and capable of carrying say about ½ ton per foot run at 20 miles an hour, is not cheaper than one of 4 ft 8½ in or 5 ft 6 in gauge, laid with 80 lbs rails, and capable of carrying trains weighing 1¼ tons per foot run at 50

* *Roorkee Treatise on Civil Engineering Railways* Fourth Edition Revised by I Wolley Dod, F C H.

miles an hour, but that, if two lines are made, one narrow and one standard gauge, *both equal to carrying the same amount of traffic*, the difference in cost will be inappreciable, that, should the traffic develop, tl

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passenger and goods vehicles for the light railway of standard gauge be constructed so as to be suitable to the heavy standard gauge, the advantage of having only one gauge more than counterbalances the

ot probable that any line

ough system will ever be made in future of a different gauge from the main lines, narrow gauge being confined to mere feeders, or hill railways, which are necessarily at the end of a line,

With regard to Volfe Barry, K C B, in his inaug *nstitution of* Civil Engineers, held strongly that they "should in all cases, other than when they will be independent approaches to a port or to a market, be of the same gauge as the standard gauge of the country" Generally, the traffic would be small and dependent on a main line, and the light railways should, therefore, be able to *carry* the trucks of the main line, thus avoiding the first cost of constructing special rolling stock, the further cost of maintaining it (with separate

delay, inconvenience, and

s as live stock, fruit, fish,

Barry was a member of the

and his statement that the saving due to the adoption of a 3 ft gauge instead of the 5 ft 3 in gauge, in the case of ten or twelve proposed light lines in Ireland, was not more than £500 a mile on the average is authoritative But even a larger saving cannot justify a break of gauge Most of the lines will be so short that the saving in construction, as between

It will be the business of the Commissioners to guard against so remote a contingency, and the business of the public to prevent the prejudicial imposition of a physical obstacle like a break of gauge

* *Min Proc Inst C E*, vol cxxvii, 1897

CHAPTER XIII

CONSTRUCTION AND WORKING

Construction of Railway—In Appendix IX will be found the *Statutory Rules and Orders* made by the Board of Trade with respect to applications to the Light Railways Commissioners for orders authorising light railways Instructions are given regarding the notice to be published in a local newspaper of an intended application for an order, the deposit of the draft order, plan, book of reference, section, estimate, and index plan with local authorities and Government departments, the scales to be adopted on the plans and sections, the previous service of notice on landowners, lessees, and others, the form in which the estimate is to be submitted, the documents to accompany the application, the fees to be lodged with the Commissioners, etc Applications must be made to the Commissioners in the month of May or November The order, if provisionally settled by them, requires confirmation by the Board of Trade

Before a railway can be opened for public traffic, it must be inspected in accordance with Act 5 & 6 Vict cap 55, ss 4, 5, 6, Act 34 & 35 Vict cap 78, s 5, and Act 36 & 37 Vict cap 76, s. 6 It has been seriously suggested that light railways, on which the axle-load is limited to 8 tons and the speed to 12½ miles an hour, should be free of all control whatever, but it is only reasonable that the Board of Trade should reserve the right of inspection—in order that they may be assured that their requirements are carried out and their regulations observed—and of imposing such additional conditions for the convenience and safety of the public as may from time to time appear to be necessary

Economy in construction depends primarily upon the location and grading of the line In light-railway work especially, direct alignment is of minor importance, every traffic point within reach must

ngth of the of avoiding tion With grade may how to take advantage of the acceleration of gravity, if the track is good enough to allow him to raise speed sufficiently to "run at a hill," as Mr A M Wellington expresses it Sharper curves open the way to flexibility in difficult country The ten to curvature, and to allow too in grading the section, may seriously handicap a promising project Physical difficulties may often be economically dealt with, in the first instance, by bringing them to a head at one point—by "bunching" grades, adopting special methods of surmounting them, zigzags, etc,—instead of spreading their treatment over a long section, and improvements in grade and curvature may be made afterwards, when expenditure on them is justified by the requirements of the traffic and the expansion of the revenue of the line It may sometimes be economical to lay the light railway on a public road, but not generally

The first temptation to be considered, in the desire for economy, will probably be that of adopting a narrow gauge, and (as has been pointed out in the previous chapter) this does undoubtedly afford an must be borne in mind, curves, such as occur in ls, depends rather upon ge, that the occupation of roads is almost as great with a narrow gauge, on account of the width of the stock, and that the adoption of a smaller gauge will scarcely relieve the permanent way and bridges, unless it is accompanied by a reduction of axle load, and unless a maximum load per foot of wheel base is also prescribed But the question has been discussed elsewhere It need only be observed here that a difference of gauge should not lightly be accepted if there is any reasonable chance of an exchange of traffic with standard lines

The occupation of land, by rent or by purchase, at its agricultural value was one of the concessions desired by the advocates of light railways Under Section 13 (1) of the Act, the compensation may be determined by a single arbitrator nominated by the parties, and *the betterment of the property by the light railway is to be taken* into account as a set off The lawyers will get less, and the owner will get a fair price for his land Enough land should be taken up in the first instance to leave room for probable future developments lest, having itself raised the value of the adjacent land, the light rail

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land is waste and the price of cultivated land, although it is liberally assessed, is not excessive Earth work is cheap for two reasons—(1) because Indian wages are low, and (2) because land can be temporarily acquired outside the permanent land and embankments made up with [illegible]

may be thus determined—

	ft	in
Gauge,	4	8½
2 Rail heads,	0	5½
Outside edge of rails to toe of slope of ballast,	9	8
Berms,	4	0
Width of formation,	18	10

On double line the width of formation will be greater by 5 ft 2 in *plus* the actual clearance between tracks—' the six foot '—which may be 6 ft or more

In India the following dimensions apply —

STANDARD DIMENSIONS, INDIAN RAILWAYS

DETAILS	5 Ft. 6 In Gauge		Metre Gauge		2 Ft 6 In Gauge	2 Ft. Gauge
	A	B	A	B		
Formation Single Line—	Ft In	Ft In	Ft In	Ft In	Ft In	Ft In
(1) Minimum width in embankment	16 6	20 0	14 0	16 0	10 0	9 0
(2) Minimum width in cutting (excluding side drain)	16 6	18 0	12 0	14 0	10 0	9 0
Curves Maximum Angle of Curvature—						
(3) In ordinary country	5 0	3° 0	8° 0	5° 0	24° 0	28° 0
(4) In difficult country	10° 0	6 0	16 0	10° 0		
Ballast—	Ft In	Ft In	Ft. In	Ft In	Ft In	Ft In
(5) Minimum width at foot of rail	10 0	11 0	7 0	7 6	6 0	5 0
(6) Minimum depth below sleepers in cuttings in rock or hard soil	0 9	1 0	0 6	0 9	0 6	0 6
(7) Minimum depth below sleepers in cuttings in soft soil or on banks	0 3	0 6	0 3	0 6		
Timber Cross Sleepers—						
(8) Minimum length	8 11	9 6	5 9	6 0	5 0	4 0
(9) breadth	0 8	0 9	0 6	0 7	0 6	0 6
(10) depth	0 5	0 5	0 4	0 4½	0 4	0 4
(11) number per mile	1760	1760	1936	1936	2000	2000

Rails—					Lbs	Lbs.
(12) Minimum weight per yard,	—	—	—	—	30	30
Weight on a pair of wheels—	Tons.	Tons.	Tons	Tons	Tons	Tons
(13) Maximum for locomotives,	15	15	8	8	6	6
(14) " " goods stock,	12	12	7	7	} 4	4
(15) " " coaching stock,	9	9	5	5		
Total Gross Weight—						
(16) Maximum for tank engine,	—	60	—	32	—	—
(17) " " engine and tender together, in the case of tender engines,	—	86	—	46	—	—
Maximum rigid wheel base—	Ft In	Ft In	Ft In	Ft In	Ft In	Ft In
(18) For passenger vehicles,	22 0	16 0	15 0	12 0	} 12 0	10 0
(19) For goods vehicles,	16 0	14 0	12 0	10 0		
Maximum moving dimensions—						
(20) Width of stock over all,	10 6	10 6	8 6	8 6	7 6	6 0
(21) Width of body,*	9 6	9 6	7 9	7 9	—	—
(22) Height above rail level,	13 6	13 6	11 0	11 0	10 0	9 0
Minimum Accommodation—						
(23) Width of seat per passenger,	1 7½	1 7½	1 7½	1 7½	1 7½	1 7½
(24) Floor area " "	3½ sq ft.	3½ sq ft	3½ sq ft	3½ sq ft	3½ sq ft	3½ sq ft
(25) Cubic capacity " "	25 cub ft	25 cub ft	25 cub ft	25 cub ft	22 cub ft	22 cub ft

A.—Absolute for any railway for all new works.
B.—Recommended for all except unimportant branches.
Items (3) and (4)—The radius of a 1° curve is 5729 578 feet.
Items (10) and (11)—Sleepers to be nearer and deeper on bridges.
Items (13), (16) and (17)—Engines in working order, with full load of fuel and water.
* In the United States the bodies of the cars are 9 ft. wide or more inside (see Voss's *Railway Car Construction*), in England 7 ft. 6 in. wide.

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(4) In difficult country	10° 0	6 0	16 0	10 0		
Ballast—	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
(5) Minimum width at foot of rail	10 0	11 0	7 0	7 6	6 0	5 0
(6) Minimum depth below sleepers in cuttings in rock or hard soil	0 9	1 0	0 6	0 9	0 6	0 6
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Weight on a pair of wheels—	Tons.	Tons.	Tons	Tons	Tons	Tons
(13) Maximum for locomotives,	15	15	8	8	6	6
(14) „ „ goods stock,	12	12	7	7	4	4
(15) „ „ coaching stock	9	9	5	5		
Total Gross Weight—						
(16) Maximum for tank engine,	—	60	—	32	—	—
(17) „ „ *engine and tender together, in the case* of tender engines,	—	86	—	46	—	—
Maximum rigid wheel base—	Ft In	Ft In	Ft In	Ft In	Ft In	Ft In
(18) For passenger vehicles,	22 0	16 0	15 0	12 0	12 0	10 0
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(20) Width of stock over all	10 6	10 6	8 6	8 6	7 6	6 0
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(22) Height above rail level,	13 6	13 6	11 0	11 0	10 0	9 0
Minimum Accommodation—						
(23) Width of seat per passenger	1 7½	1 7½	1 7½	1 7½	1 7½	1 7½
(24) Floor area „ „	3½ sq ft.	3½ sq ft	3½ sq ft	3½ sq ft	3½ sq ft	3½ sq ft
(25) Cubic capacity „ „	25 cub ft.	25 cub ft	25 cub ft	25 cub ft	22 cub ft	22 cub ft.

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* In the United States the bodies of the cars are 9 ft wide or more inside (see Voss's *Railway Car Construction*), in England 7 ft. 6 in wide.

Proposals to cut down the ballast should be received with caution It may be an expensive item, but in regard neither to its quality nor to its quantity can we afford to be niggardly. Good, clean, and sufficient ballast not only forms a necessary foundation for the permanent- [illegible] fastenings [illegible] open line, [illegible] onomical, [illegible] struggle into existence In England such a proposal is not likely to be made, and the Commissioners would certainly not sanction it

The rail is, as [illegible] item of expense [illegible] of the rolling st[illegible] extent, almost every other detail of the line" The weight and form of the rail to be adopted is a question of the first importance

It must not be supposed that the working value of a 40 lb rail is as much as half of that of an 80 lb rail, it has only one fourth of the stiffness and little more than one third of the ultimate strength, while, in regard to durability, wear must tell more rapidly upon the lighter than upon the heavier section As a rough rule, however, the weight of the rail in lbs per yard is commonly taken at five times the maximum axle load in tons and in India we carry 15 ton axle loads on 75 lb rails A smaller co efficient—say 4—might be permitted for light railways worked at slow speeds At the same time, the Commissioners should not object to the use of second hand rails—for main lines making light railways may wish to utilise them—provided they are not too much worn, and their actual weight more than covers the rough rule quoted above

The Vignoles or flat footed rail, commonly used in India and on the Continent, would be the most economical to adopt on light railways, for it enables us to discard chairs and to use dog spikes, the cheapest of fastenings The table given on page 201, although the prices are expressed in rupees, will indicate roughly the saving thus effected

The cost of the 75 lb double headed rail in chairs on wooden sleepers is $14\frac{1}{2}$ per cent greater than that of the 75 lb flat-footed rail dog spiked to wooden sleepers On light railways a further saving may be effected by discarding the bearing plates In that case, the joint or guard sleepers should be double spiked on the outside of the rails, and on sharp curves every sleeper should be double spiked on *the outside of the outer rail Coach screws and clips or fang bolts* may also be used as fastenings, but are more expensive, of course, than dog spikes For very light lines on the "ladder" system of portable railways—each section of permanent-way consisting of a pair of rails with its complement of sleepers riveted on—the reader may refer to the illustrated catalogues of Messrs John Fowler & Co and the Decauville Company.

The intervals between two adjacent running lines of rails on the standard 4 ft 8½ in gauge must not, under the requirements of the Board of Trade, be less than 6 ft, this is also the minimum interval between lines of rails and sidings, but 8 ft is better. Clearances of 6 ft and 8 ft are equivalent to distances between tracks, centre to centre, of 11 ft 2 in and 13 ft 2 in respectively. These dimensions would apply to light railways on the standard gauge, but the latter are not likely to include double running lines, except for short distances under exceptional circumstances.

WEIGHT AND COST PER MILE OF SINGLE TRACK OF DIFFERENT DESCRIPTIONS OF PERMANENT WAY IN INDIA

Description	Weight		Cost Landed in India	
	Tons		Rupees	
75 lb F F rails fish plates bolts and nuts	126·54	221·82	13 264	24 233
Transverse steel sleepers and keys,	95·28		10 969	
75 lb F F rails, fish plates bolts and nuts,	126·54	253·13	13 264	21 549
Bearing plates and spikes	10·97		2 272	
Indian timber sleepers	115·62		6 013	
75 lb D H rails fish plates bolts and nuts	127·48	350·48	13 372	33 600
Cast iron (Denham Olphert's) plate sleepers complete,	223·00		20,228	
75 lb D H rails fish plates bolts and nuts	127·48	314·63	13 372	24 678
Cast iron chairs and spikes	58·59		4 495	
Indian timber sleepers and wooden keys	128·56		6,811	

Wooden trestling where timber is cheap and plentiful, is a favourite economy in America. They are of course, liable to catch fire, but, being recognised as temporary structures, they are supposed to be carefully watched, and it is argued that a properly designed timber trestle is at any rate better than weak masonry or steel spans. They are not only used as substitutes for high embankments in first construction, but as dry viaducts to be replaced by permanent bridging when the prosperity of the railway is such as to justify expenditure on improvements. The timber troughs and timber bridges which carry the Three Horse Shoes and Benwick (G E R) light goods line across the dykes and engine-drains of the fens are described in Chapter XV, but it is doubtful whether such a form of construction would be

speeds

Fencing is not usual on Continental light railways except in populated places In France the Prefect of the Department may, under the law of 1880, exempt light railways from the obligation (rigidly imposed on the main lines) of providing continuous fencing and level-crossing gates Fencing, therefore, is seldom provided in country districts, although it may be required in passing through inhabited parts, around station yards and some distance out on each side, to flank level crossing gates along the line in each direction, or to protect the traffic of a public road Even in such cases the narrow gauge lines appear to be privileged (*e g*, the station in the streets of Salle nelles on the 2 ft 6 in railway from Caen to Dives and Luc sur Mer) "The Belgian State Railway," says Mr P. W Meik,* "has determined to abolish fencing on all light railways, except where there are special circumstances" In Italy, as we have seen, the lines running on the side of the public roads are not fenced This is true also of the Wisbech and Upwell line in Cambridgeshire, running along the side of a public road, and, had the Three Horse Shoes and Benwick line been constructed under the Light Railways Act, fencing would not probably have been required in the open fen country

It will, in England, be difficult to dispense with fencing where the light railway intersects hedges and other boundaries which divide one field or property from another, but, wherever reasonable cause for doing without it can be shown, the Commissioners will not, we may be sure, insist upon the provision of so expensive an item An American "cattle trap"—*i e*, a grated pit over which the rails are laid on baulks of timber—would, of course, complete the physical boundary where a railway made a gap in a hedge, but such an awful device would never be dreamed of in England

Elsewhere such cattle traps are sometimes used at level crossings, being built across the railway, on each side of the public road, from fence to fer [illegible] the road o [illegible] charge of [illegible] and building a house, as well as the pay of a gatekeeper, are saved

On Continental railways the gate is frequently kept by a plate-layer's wife on small wages, the gate house being given to them as quarters, so that it is not merely an extra expense connected with the [illegible]

* *International Railway Congress Bulletin*, 1895

even at unguarded level crossings Indeed, we find that, in 1893, on Belgian State railways there were twenty one accidents (nine fatal) on *watched* level crossings, and only ten (seven fatal) on *unwatched* crossings, the evidence of the Western of France is that there are not appreciably more accidents on the former than on the latter,* while others report that they have had none The late Lord Bramwell, who had a very proper contempt for grandmotherly legislation of all kinds, may very well be quoted at this point †—"But, besides this, I look upon all those rules, regulations, and provisions (e g, watchmen [illegible] care of people when they [illegible] mischievous" [illegible] ays will, we may assume, [illegible] tions, therefore will have to be designed and worked under such very different conditions from those which exist on double line standard railways, a note written by the author—and issued by the Public Works Department of India, Railway Branch, as *Technical Section Publication, No* 54—is here placed before the reader —

"NOTE ON THE DESIGN OF STATION YARDS ON SINGLE LINES IN INDIA

"*By W. H Cole, Deputy Manager, Eastern Bengal State Railway.*

"I was asked to make a digest rather than a translation of M Flamache's paper,‡ and to add my views on adapting his ideas to our own circumstances in a technical paper for discussion at the next Conference

"I found that M Flamache's paper was too concise for abridgment, and that station plans for double lines could not be adapted to single line requirements by simply pinching the two main lines into one It was scarcely to be expected that we could move so easily from the simpler conditions of double line working to the solution of [illegible]

avoid occupation of the main lines as much as possible, and to provide refuge sidings for slow trains to allow a fast train to pass or (on our single lines) *cross* them

"We must also make the best arrangements we can for attaching and detaching vehicles, and—at junctions or traffic-changing stations —for sorting and marshalling goods and mixed trains.

"Having premised so much, I wish to add that Mr P D Barclay (Traffic Superintendent, Eastern Bengal State Railway) has not only

* Meik on "Relaxation of Normal Requirements,"—*International Railway Congress Bulletin* 1895

† Stubley v L N W. Ry Co. (*L R* 1, Ex. 13)

‡ *Bull de la Comm Int du Cong des Ch de Fer*, Nov 1894

permitted on a light railway carrying passengers There is, however, no reason why old wrought iron girders from the main line should not be used, if they are strong enough to bear lighter loads at slower speeds

Fencing is not usual on Continental light railways except in populated places In France the Prefect of the Department may, under the law of 1880, exempt light railways from the obligation (rigidly imposed on the main lines) of providing continuous fencing and level crossing gates Fencing, therefore, is seldom provided in country districts, although it may be required in passing through inhabited parts, around station yards and some distance out on each side, to flank level crossing gates along the line in each direction, or to protect the traffic of a public road Even in such cases the narrow gauge lines appear to be privileged (*e g*, the station in the streets of Sallenelles on the 2 ft 6 in railway from Caen to Dives and Luc sur Mer) "The Belgian State Railway," says Mr P W Meik,* "has determined to abolish fencing on all light railways, except where there are special circumstances" In Italy, as we have seen, the lines running on the side of the public roads are not fenced This is true also of the Wisbech and Upwell line in Cambridgeshire, running along the side of a public road, and, had the Three Horse Shoes and Benwick line been constructed under the Light Railways Act, fencing would not probably have been required in the open fen country

It will, in England, be difficult to dispense with fencing where the light railway intersects hedges and other boundaries which divide one field or property from another, but, wherever reasonable cause for doing without it can be shown, the Commissioners will not, we may be sure, insist upon the provision of so expensive an item An American "cattle trap"—*i e*, a grated pit over which the rails are laid on baulks of timber—would, of course, complete the physical boundary where a railway made a gap in a hedge, but such an awful device would never be dreamed of in England

Elsewhere such cattle traps are sometimes used at level crossings, being built across the railway, on each side of the public road, from fence to fence Cattle and sheep are thus prevented from straying off the road on to the railway, and a gatekeeper need not be placed in charge of the level crossing in which case the cost of erecting gates and building a house, as well as the pay of a gatekeeper, are saved

On Continental railways the gate is frequently kept by a platelayer's wife on small wages, the gate house being given to them as quarters, so that it is not merely an extra expense connected with the provision of a level crossing Our own standard railways are generally forced to carry public roads over or under the lines, not to cross them on the level But with light railways we shall have to get more accustomed to level crossings, and to look after ourselves in crossing them Continental experience is that very few persons are run over,

* *International Railway Congress Bulletin*, 1895

even at unguarded level crossings Indeed, we find that, in 1893, on Belgian State railways there were twenty one accidents (nine fatal) on *watched* level crossings, and only ten (seven fatal) on *unwatched* crossings, the evidence of the Western of France is that there are not appreciably more accidents on the former than on the latter,* while others report that they have had none The late Lord Bramwell, who had a very proper contempt for grandmotherly legislation of all kinds, may very well be quoted at this point †—"But, besides this, I look upon all those rules, regulations, and provisions (*e g*, watchmen at level crossings), which are made to take care of people when they should take care of themselves, as positively mischievous"

Stations and Signals—As light railways will, we may assume, consist entirely of single lines, and the stations, therefore will have to be designed and worked under such very different conditions from those which exist on double line standard railways, a note written by the author—and issued by the Public Works Department of India, Railway Branch, as *Technical Section Publication, No* 54—is here placed before the reader —

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"I found that M Flamache's paper was too concise for abridgment, and that station plans for double lines could not be adapted to single line requirements by simply pinching the two main lines into one It was scarcely to be expected that we could move so easily from the simpler conditions of double line working to the solution of the far more difficult and complicated single line problem

"We must work out the design of single line stations from the beginning, and independently, but in doing this we should be guided by the same principles as M Flamache Our object should be to avoid occupation of the main lines as much as possible, and to provide refuge sidings for slow trains to allow a fast train to pass or (on our single lines) *cross* them

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revised the translation of M Flamache's paper, but criticised my plans one by one I am also indebted to Mr A R Jacobson (Assistant Traffic Superintendent, Eastern Bengal State Railway) for his opinions and suggestions In cases of this sort, it seems to me, satisfactory results can only be obtained by friendly discussion between the Traffic and Engineering Officers interested in the question

"The simplest arrangement for crossing trains is shown in fig A,* and involves the use of only one set of points and crossings An up train, making way for another, would run direct into siding *a*, but would have to back out on to the main line before resuming its journey, a down train would back into the siding, and stand there ready to make a direct exit after the other train had cleared the block

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points Next we may recognise

form to one side or the other, *c*

dotted line *e* Ultimately, we

with a 'scissors' arrangement of crossovers, which occupies less space

"T e, Mr Raynar Wilson (of the

Lanc the author of the excellent

serie g published in *The Railway Engineer*) wrote —

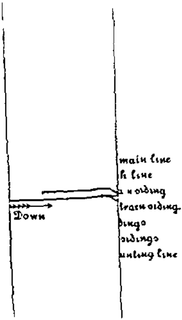
"'I have some difficulty in speaking of the system of signalling adopted in India, as the conditions—as you remark—are so very different and, having been trained to having a Board of Trade to deal with, my ideas of economical signalling have been somewhat stunted Has it ever occurred to you or your colleagues to put in passing loops thus?' And then he sketched the plan shown in fig C

"The shunting necks from *a* to *b* and from *c* to *d* must be capable of stabling our longest trains A down train has to pass an up-train here, the down train arrives first, stops at the platform, does its work, proceeds over crossing *e c* to *c d*, and backs into *a b*, it is now in a position—on the arrival of the up-train—to make a direct start from *b* through the crossover *b f* If the up-train arrives first, after doing its work at the platform, it has merely to back over the crossover *e c* into the siding *c d*, and is then ready for direct exit after the down train has passed

'Eliminating the starting and shunting signals, we may bring our main signals right up to the fouling points, as shown in fig D, or the distance between *e* and *f* being not more than about 300 feet, a two armed central main signal may be substituted for two separate masts

"The simpler plan indicated in fig B has, so Mr Wolley Dod informs me, been used occasionally in India and largely in America, but I have not had the advantage of seeing this type myself 'An objection to it is,' he says, 'that two trains arriving about the same

* The figures referred to in this note are those shown in Plate II



jj -reversing line
k turntable
ll loco line
mm branch platform lin
nn stock lines
oo marshalling siding
pp qq shunting lines

revised the translation of M Flamache's paper, but criticised my plans one by one I am also indebted to Mr A R Jacobson (Assistant Traffic Superintendent, Eastern Bengal State Railway) for his opinions and suggestions In cases of this sort, it seems to me, satisfactory results can only be obtained by friendly discussion between the Traffic and Engineering Officers interested in the question

"The simplest arrangement for crossing trains is shown in fig A,* and involves the use of only one set of points and crossings An up train, making way for another, would run direct into siding *a*, but would have to back out on to the main line before resuming its journey, a down train would back into the siding, and stand there ready to make a direct exit after the other train had cleared the block

"The next development might take the form either of two turnouts, *a* and *b*, facing each other, as shown in fig B, or of a loop Adopting the former, we may place the platform and home signals opposite the points Next we may recognise the desirability of shifting the platform to one side or the other, *c* or *d*, and of filling in the intermediate dotted line *e* Ultimately, we arrive at the plan shown in fig C, wi hich occupies less space

Rajnar Wilson (of the

La author of the excellent

ser lished in *The Railway Engineer*) wrote —

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fig C

apable

p-train

work

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"Eliminating the starting and shunting signals, we may bring our

objection to it is, he says, that two trains arriving about the same

* The figures referred to in this note are those shown in Plate II

time actually cross one another s paths but for all intents and purposes they do so with a loop if
fact of knowing that they do so
the signal, would tend to make

e, as indicated in fig E,

be preferred because it offers a better view of the straight through line in both directions and affords room for unlimited expansion * while the addition of a loop to plan E involves either the setting back of the platform, as in fig G, or some such awkward arrangement as that indicated in fig H The further development of F will take the form of either I or J, of which plans J is the better, and the next extension will take the form of another loop, as shown in fig K In Technical Section publication No 32 I set forth the advantages of the station plan indicated here in fig L All trains enter on the left hand road and slow trains to be crossed by fast ones are backed into dead sidings clear of the

and the signalling required is of the simplest description This type does not, however seem to commend itself to traffic men They acknowledge that it is an excellent 'crossing' station, since no less than five trains can be dealt with at one time,—viz, one up- and one down train in the sidings one up and one down train on the loop lines and either an up- or a down train on the main line,—and the standing trains are all in position for proceeding on their journey But they dislike back shunting our long goods trains, and object to the time lost in the operation, they prefer the direct entry afforded by more loop lines, they object to being forced to follow the left-hand road always and they would rather adhere to the present practice of doing all their work on one platform It may be observed (as in my previous paper) that if a train has to wait at a station to allow
in shu
lines
them, that a dead siding, while affording the same accommodation as a loop line, is more economical, since it requires only one set of points, and an inferior class of material can generally be used (it can al o be

* It is however, a slight advantage to have the straight line, on which fa trains may run through away from the platform

provided with trap points to prevent the possibility of a train leaving *it when it should not do so, whereas trap points are objectionable in* loops through which trains occasionally run at speed), and that the arrangement with several loops, if properly signalled, entails the provision of ten or even twelve signals instead of four, and of much more costly and complicated interlocking

"To return to the development of plans A, F, J, K—the next question to consider is the position of the goods shed, platform, and sidings Shall these be placed opposite, or on the same side as, the booking office? The choice lies between the arrangement indicated in figs M and N and that shown in fig O

"I find one traffic officer preferring plan M to plan O, because, he

'l line in
on that
ods plat-

form and shed should never be directly opposite the booking office, and he would adopt the plan which I have sketched in fig O

"I must say that the concentration is more apparent than real in fig M, and that, while the distance between the goods shed and the booking office is no greater in fig O than in fig N, the station master can supervise the whole much more easily, because both booking office and goods shed are on the same side

"I th
which I
improve
senger a
railway, and the further advantages claimed for plan M apply equally to plan P

"The next difficulty to discuss is that of junction stations. As the manager of one of our Indian railways reminds me, the real problem at junctions is to deal with mixed trains

"The nucleus of my idea of such a station is indicated in fig Q The main line is double to stations not more than 3 or 4 miles away on each side, in order to clear the junction, down trains for the branch, or continuing their run on the down main line, and up branch trains proceeding on the up main line, may be dealt with directly, up trains from the main line running down on the branch may use *the reversing line, which will also be utilised when engines have to be* changed or reversed, or if a branch train can more conveniently be received on the branch side of the island platform

have not that paper at hand —

traffic
traffic
is they
approach the end of the run Considerable relief would often be afforded if the first two station distances in each direction were only half the average station distance, and, further, if the line were doubled as far as the first station in each direction'

"The diagram in fig R, where d = average distance between stations, illustrates precisely what is meant

"The possible development of such a junction station type as that indicated in fig Q is suggested in fig S

"The object of this design is to offer the utmost facilities for

"Mixed trains, which have to be made up or split up in connection with the division of traffic between the main and branch lines, can be dealt which—by means of the shunt rom either end, and are practic ird
us not to cramp and
ween the main and
common trunk lines
between the down
main and branch platform lines

"Wagons to be attached to an up main line train can be arranged, a new engine can be placed, or a slow train shunted back clear of the main line on the up sidings d and $f\,f$, and the shunting line h—although not absolutely necessary—would be very convenient, similar remarks apply to the corresponding sidings e, $g\,g$, and i, on the down main line

would utilise the
the engine, before
The reception of
or down on the

"W H C

"CALCUTTA, 21*st Sept* 1895"

In so far as the Board of Trade can be moved to relax their requirements in regard to signalling and interlocking in favour of light railways, a very important economy can be effected in construction

and working, and the consideration of this question is immediately connected with the arrangement of single line station yards Before we discuss the simplifications and economies to be sought for in signalling and interlocking light railway stations, it will be useful to describe as briefly as possible the functions of signals and the requirements of the Board of Trade on standard railways —

"Fixed signals* consist of home, distant, starting, and siding signals

"The home signal may be placed at a station (fig 3, I, H S, page 209), junction (fig 3, II, Nos 4, 6, 8, 10), siding, or signal box, and is an *absolute stop signal* It should be placed at a sufficient distance from ntally drawing a littl signal at danger, or f ept as prescribed in ne to the other, or than junctions) star ry to bring the train under the protection of the home signal

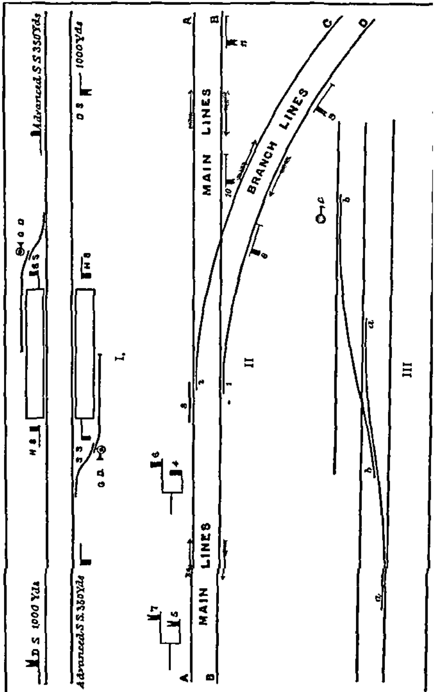
"The distant signal (as in fig 3, I, D S) is fixed at a sufficient from the when *ne and the starting signals* have been lowered. When, however, the distant signal is at danger, the driver must be ready to pull up at it, if necessary, but, if the road be clear, he may proceed cautiously (so that he may stop short of any obstruction) and bring his train to a stand as near the home signal as the circumstances of the case will allow The distant signal should be distinguished by a fish tail notch cut out of the end of the arm

"Starting signals (at stations placed generally at the end of the platform) and advanced starting signals control the departure of trains into the section ahead, and must not be passed, when at danger, except where it is necessary to shunt over points and crossings or cross over

line is clear, the signal to a stand, lower the

signal, and no further The advar limit up to which a train may be d signal in order to leave the pla purposes, or other station duties generally placed (as in fig 3, I) 300 to 350 yards in advance of the

* *Notes on Permanent Way Material Platelaying, and Points and Crossings*, by W H Cole, pp 128 to 132 (E. & F N Spon).


D S 1000 Yds
Advanced S S 350 Yds
Advanced S S 350 Yds
D S 1000 Yds
H S
S S
G D
I.
MAIN LINES
MAIN LINES
BRANCH LINES
A
B
C
D
II
III

cabin, so that a train of maximum length may clear the section in rear without entering the section ahead, and it should be clearly visible to the driver from the platform starting signal, as well as to the signalman in the cabin

" ground disc (fig 3, I, G D) train must leave the siding

osts or on brackets Where a post, the first or top arm applies to the line on the left, the second arm to the line next in order from the left, and so on, but, if the main or important line be not the one on the left, the signals must be on separate posts or brackets.

"

the upper signal, so that it cannot possibly be pulled off when the latter is at danger It
7 ft apart, so the dista
signal At a junction,
respective home and starting signal

"Every signal arm must be weighted, so as to fly to danger if the connection between arm and lever should break at any point

"The front signal lights are red for 'danger,' and green for 'all right', the back light (visible only when the signal is at danger) white This is not obligatory on existing lines, or on new lines run over by companies using a different system of lights For the sake of distinction, the danger lights of bay starting and other minor signals are often purple instead of red

"Signals are usually worked by wires, the 'slack' of which is better regulated by hand adjusters in the signal cabin than by self acting so called compensators

ignals, their ' of Trade in them must be considered.

"Points must be worked or bolted by rods, the effect of varying temperature on rods of 100 ft. and upwards in length being corrected by self acting compensators

"Facing points should be avoided as far as possible. They must not be worked from a greater distance than 180 yards, and should be placed as near as practicable to the levers by which they are actuated In the case of trailing points on the main line, or safety points of sidings, the limit of distance from the levers is 300 yards. This is the English practice, but on the Continent these limits are considerably exceeded, and with perfect safety

"To secure facing points in their proper position they must be bolted by a locking plunger passing through the stretcher bar; and, to prevent the signal from withdrawing the bolt while a train is pass-

ing over the points the plunger must be fitted with a locking bar to suit the longest wheel base of the rolling stock The plunger and locking bar may be worked either by a separate lever or by the lever which also works the points

"The first step towards the interlocking of points and signals is the concentration of the levers in one frame

"The point and signal levers must be so interlocked—that a signal cannot be lowered for a train until the points have been properly set and locked that any two signals which might lead to a collision cannot be exhibited at the same time and that, after signals have been lowered for a train to pass, no points connected with, or leading to, the line on which the train is running can be moved Home or starting signals, next in advance of trailing points, when lowered, must lock the points in either position, unless this locking will unduly interfere with the traffic

"Points also, if possible, are to be so interlocked as to avoid the risk of a collision by over running

"*A distant signal must not be capable of being lowered unless the home and starting signals in advance of it have been lowered* *

"Detectors must also be fitted, in order to ensure that the points are properly set before the signals are lowered and to discover any failure in the connections between the levers and the points Otherwise, if the rods were buckled or broken, a lever might be pulled over without any corresponding movement of the points

"From the foregoing remarks—in which are included the present requirements of the Board of Trade—it will be seen that there are few absolute rules for the precedence of levers, etc The interlocking is generally arranged to suit the requirements of the junction or station to which it is applied

"Whenever it is p
(independently of the
switches may be set t
backing or otherwise The case of an ordinary double junction may be taken as an example (fig 3, II, page 209).

"If a train from A on the main line is to proceed on the branch towards C over facing points 2, it is necessary, before making the road from main to branch to turn over points 1, so that if a train on the other line B B were backed over points 1, it would not foul the train from A when the latter was crossing the main line B B The order of working would, therefore, be 1, 2, 3, 4, 5 The levers having been put back in reverse order, a train running over facing points 2 on the main line A A would require levers 3, 6, 7 to be pulled over in succession

"For a train running on the main line B B over trailing points 1 the order would be 3, 10, 11, so that a train coming from the opposite direction on the other main line could not cross it.† If, however, a

* In interlocking this means that the distant signal must also be put back to danger before the home and starting signals

† A passenger train going from A on the main line to C on the branch may be

train from D on the branch were entering the main line over points I, it would be impossible to trap another train from the main line B B running in the same direction and over the same points Neverthe less, an accident could only take place through disobedience of signals for when the road is made from branch to main line, signal 10 (and, therefore 11 also) is locked at danger

"Again where (as in fig 3, III, page 209) we have a siding or slip road in a cross over road, the cross over points *a* should precede the siding points *b* which in turn would precede the signal *c*

"It is now required that the starting as well as the home or stop signal shall precede the distant so that should a driver approach a station or junction where the distant signal is down, he will know that not only is the station clear but the section in advance also

"If the distant however, be at danger, and the home signal only is lowered as described below, the driver will know that the station is clear but the section in advance is blocked and that he must stop at the station until the starting signal is lowered The rule is that, so long as the starting signal is at danger, the home and distant signals must be kept at danger, except on the near approach of a train which has to stop at the station when, after the speed of the train has been reduced so as to admit of its entering slowly and being pulled up at the platform, the home signal may be taken off to admit the train, but the starting signal must be kept at danger until the section in advance is clear, in the case of a train not booked to stop, the home signal must not be lowered to admit the train until the train

is not required, the home or starting signal should be controlled from the station in advance This is generally done on the signal itself, although there are cases, but very few, where, in mechanical bolt-

effected until the stroke has been completed,

"(2 arranged,

"(3 such space in front of the levers having the best possible view of the railway, nor such space at the back as will not allow him to stand well up to the levers,

stopped and made to wait for a goods train running on the other main line B B over points I as the former can be trapped and a collision averted if the driver over runs signals while the latter cannot.

"(4) That the locking shall not be arranged vertically, which practically prevents a large cabin from being placed across the lines (the most favourable position),

"(5) That, for choice, the locking be arranged in horizontal tiers beneath the floor of the cabin,

"(6) That the locking may be easily got at for cleaning, lubricating, alterations, or repairs, and, so far as possible, without occupation;

"(7) That there shall be as few wearing parts as possible—the less friction, the less the effort to work the levers, and the less wear and tear of the parts,

"(8) That the parts shall be, as far as possible, interchangeable,

"(9) That ordinary repairs, alterations, or additions may be made without the aid of an expert,

"(10) That, although sufficiently sensitive, the apparatus shall not be delicate, or require too much attention,

"(11) That its effective working shall not be affected by variation of temperature,

of that in the long run may be doubted"

On a light railway worked on the "one engine in steam or two coupled" system—which the French more concisely and expressively call "la navette," it is obvious that no signals are necessary, nor are they required at mere stopping places, nor at intermediate sidings controlled by staff or tablet, but they will have to be provided at all stations where trains cross or pass each other

In India, as in South America and elsewhere, it has been a common practice to erect a tall mast in the middle of the platform, with one arm to admit an *up* train on either line of the loop, and another arm to admit a *down* train on either line of the loop, without any interlocking whatever The loops are very long, because full wagon loads and full train loads are an essential condition of economical working on most Indian lines, while time is less important. Distant signals are placed at a considerable distance beyond the facing points, and may be lowered quite independently of the main signal, the custom being to lower it *before* the main signal arm is lowered When the distant signal is at danger the driver must stop with the *tail* of the train protected by the distant signal, and must not proceed until the main signal is lowered, when he may enter the points, pass the main signal opposite the middle of the station, and pull up at the platform in the most convenient position for his train The points are bolted and padlocked, the keys being held by the
man The stationmaster is responsible for the facing
properly set and bolted to admit an incoming train, but the
responsibility consists of moral, not of mech

may seem to be a very loose one, but it has worked well enough under the strain of considerable traffic on our Indian single lines. Gradually, however, with the growth of business, Indian railways are

the main signal is recognised as an absolute stop signal Distant signals do not precede the main signal, but actually indicate to the driver the position of the arm on the latter The last step, which really may be deferred without much inconvenience, is to provide starting signals.

On the North Western Railway of India—of which the writer was recently deputy manager—the ordinary crossing stations are gradually being fitted with List and Morse's patent signals The practice is to receive the train either on the main line or or the loop line, as may be convenient, and not necessarily on the left hand road of the loop This custom is so universal in India that the traffic officers will not listen to any proposal to introduce the English rule Accordingly, a home signal is erected at the facing points at each end with two arms, one admitting to the main line and the other to the loop siding The points are locked by keys entrusted by the stationmaster to the pointsman There are two keys for each end of the station, one for the main line, and one for the loop When the points have been locked by one of these keys, the pointsman moves a lever which frees the proper signal and locks the key in The signal can then be lowered from the platform by the stationmaster, and the lowering of the signal locks up the lever at the points, so that the points cannot be again unlocked until the signal has been put to danger by the stationmaster This places the admission of trains entirely under the control of the stationmaster The lock on the points is between the rails, so that the key can neither be placed in it nor taken out of it while a train is passing The distant signal has only one arm, which can be lowered by means of a lever at the points when either of the main signal arms has been lowered, but not before When the main signal arm is again raised to danger, the distant signal arm is automatically thrown up to danger also

At the writer's request, Mr A Morse (Executive Engineer, North

Mr Morse's note is as follows —

List and Morse Signals

"The arrangement shown in the accompanying drawing works as follows —

"One of the levers in the two lever frame on the platform, when pulled, works the up home signal, and, when pushed, works the down starter The other lever similarly works the down home and up starter

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At the writer's request, Mr A Morse (Executive Engineer, North Western Railway) furnished a note and plan (Plate III) for adapting this system to a station yard such as that shown in Plate II, fig P, with the addition of starting signals, and in accordance with the writer's proposal to admit trains on the left road only, as in England Mr Morse's note is as follows —

List and Morse Signals

"The arrangement shown in the accompanying drawing works as follows —

"One of the levers in the two lever frame on the platform, when pulled, works the up home signal, and, when pushed, works the down starter The other lever similarly works the down home and up starter.

TABLE OF LOCKING FOR CABIN, PLAN B, PLATE IV

No	Description	Released by	Locks
+	Siding Lock for *a* Frame		2
1	Distant Signal	2	
2	Home Signal		+3
3			⊕2
4	Distant Signal	3	
⊕	Siding Lock for *b* Frame		3

TABLE OF LOCKING FOR FRAME *a* OR FRAME *b*, PLAN B

No	Description	Released by	Locks
1	Points	Siding key	
2		1	

In both plans the facing point locks and lifting bars are worked on the same levers as the points with special escapement cranks Slip points have ground discs or else scotch blocks The approach for trains entering the loop is shown as a straight road over the facing points This makes the entrance easy, but is only of particular importance where trains run through stations at speed

quired of any light standard railways he simplest descrip- given case, is the signals, etc., on a light railway

At a crossing station we may reasonably be called upon to erect a central main signal with two arms, and thus save wire, and to bolt or clamp and padlock our points, if the loop be a long one, it may be necessary to place a home signal at each of the facing points, and to work it from the station platform. Preferably, trains should always be admitted on the left-hand road, in that case a one-arm home signal is all that is required at each of the facing points, and a very simple arrangement will render it impossible to lower the signal unless the points are set for the left-hand road If trains are to

cabin. Each train must enter the loop on the left line, and this condition simplifies the signalling very much indeed. Starting signals are not provided The frame at the centre of the station contains ten working levers, as follows :—

TABLE OF LOCKING, PLAN A, PLATE IV.

No.	*Description.*	*Released by.*	*Locks.*
1	Distant Signal,	2	.
2	Home Signal,		3, 5, 6, 9
3	Points		2
4	,	3	8, 9
5	,,		2, 6
6	,,	7	5, 2
7	,,		9
8	,,		4, 9
9	Home Signal,		2, 4, 7, 8
10	Distant Signal,	9	

ur lever
a two
ing be
side is
pensive
ground
frames *a* and *b* might be placed actually at the points or at any distance from them, not exceeding 180 yds or 540 ft, towards the *station, so as to save time in taking the safety keys to and fro The* plan shows them placed for a loop 2080 ft long The trains are admitted on the left hand road No starting signals are provided
ne *c* to unlock
r, nor can the
et for the left
ne *a* and used
he working of
the yard in a
similar way

The cost for signalling without sidings was estimated at about £220 (fittings delivered f o b London or Liverpool), and with sidings at £280

TABLE OF LOCKING FOR CABIN, PLAN B, PLATE IV

No	Description	Released by	Locks
+	Siding Lock for *a* Frame		2
1	Distant Signal	2	
2	Home Signal		+ 3
3	"		⊕ 2
4	Distant Signal	3	
⊕	Siding Lock for *b* Frame		3

TABLE OF LOCKING FOR FRAME *a* OR FRAME *b*, PLAN B

No	Description	Released by	Locks
1	Points	Siding key	
2	"	1	

In both plans the facing point locks and lifting bars are worked on the same levers as the points with special escapement cranks Slip points have ground discs or else scotch blocks The approach for trains entering the loop is shown as a straight road over the facing points This makes the entrance easy, but is only of particular importance where trains run through stations at speed

Nothing more expensive than this should be required of any light railway In Plan B, rodding—a costly item on standard railways

he simplest descrip

given case, is the

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At a crossing station we may reasonably be called upon to erect a central main signal with two arms, and thus save wire, and to bolt or clamp and padlock our points, if the loop be a long one, it may be necessary to place a home signal at each of the facing points, and to work it from the station platform Preferably, trains should always be admitted on the left-hand road, in that case a one arm home signal is all that is required at each of the facing points, and a very simple arrangement will render it impossible to lower the signal unless the points are set for the left-hand road If trains are to

be admitted on either line, the signal must have two arms, but, in this case also, it will not be difficult to make it impossible to lower the signal arm until the points are set in the position to which it applies, and, in lowering that arm, the signal rod may be made to stab the point rod and hold it in position Distant signals need only be provided where the home signal cannot be clearly seen by the driver from a distance of, say, a quarter of a mile from the facing points, or where the approach is on a steep decline into the station Starting signals are really not necessary Wherever junction is made with a main line of railway, it will have, of course, to be signalled and interlocked in accordance with Board of Trade requirements for standard railways

Considerable saving can be effected if we are able to dispense with raised platforms at stations If the station is in embankment, and the platform walls have to be carried to some depth to get below the made up earth, they are costly If raised platforms are provided at all, they should be of convenient and uniform height, and this is particularly important on a busy suburban line, where the stoppages are short and passengers have to get in and out as quickly as possible On light railways, however, if the carriages have end doors and steps passengers will find little difficulty in entering or alighting, even when the ground is merely made up to rail level In any case, the principle laid down in No 11 of the Board of Trade requirements, "that each line shall have its own platform," should, if possible, be adhered to

In accordance with the requirements of the Board of Trade, turn tables of sufficient diameter to take the largest engine and tender in use, without their being uncoupled, must be erected at termini, junc tions, and other places where engines have to be turned, except in cases of short lines not exceeding 15 miles in length, where the stations are not more than 3 miles apart, and all trains stop at all stations The exceptions are likely to cover the majority of light railways in England Shorter turntables will suffice for tank engines and triangles may be laid down instead of turntables, if required If engines which can be driven from either end are used as on the Belgian light railways it will not be necessary to turn them

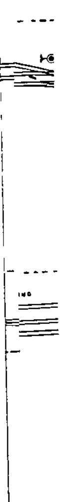
One or two water tanks, measuring 8 ft by 8 ft by 4 ft, supported on a rail truss at such a height as will afford sufficient head for the supply of water to the engine from a water column will probably be all that need be provided at any station where the engine is obliged to water From the reservoir or well, which is the source of supply, the water may be lifted into the tank by means of a hand pump

Station buildings should be constructed on the most modest scale A small open shed to shelter passengers, a small office, and a goods lock up may suffice at first

Mile posts and gradient boards will cost very little, and should be provided

Rolling-Stock.—If the light railway is built to take the goods

G1



wagons off the main line with which it is connected there will be a saving in rolling stock If a narrower gauge is adopted, separate stock is, of course, absolutely nece ary with separate repairing shops etc while if, with a view to obviating the difficulties and inconvenience of transhipment as much as possible, narrow gauge bodies are transferred to standard gauge frames this not only means the pro

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d on of the project of the proposed Nowshera Dargai 2 ft gauge line, illustrate very well the principal points to be observed in keeping down the cost of a light railway —

"(i) Estimates to be prepared for a line starting from the left bank of the Cabul river

An estimate for bridging that river is not required

(ii) Land for a 2 ft 0 in gauge is to be estimated for

(iii) All culverts to be built of dry stone, or stoneware pipes or

bents

(iv)

(v)

(b) Alternative estimates for permanent way to be prepared providing (1) for new 25 lb steel rails and steel sleepers, and (2) for old iron rails and wooden sleepers

(vi) Stations and buildings to be sheds only, built of rail uprights, etc, and roofed with corrugated iron sheets

No platforms are required

(vii) Locomotives of the Darjeeling Himalayan Railway latest type, as noted in the margin, to be provided for

B class —Haul on level 840 tons
Incline 1 in 100 210 tons
Incline 1 in 26 50 tons
Round curve of 60 ft radius
Fuel 30 lbs coal per mile (average

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Estimate of Cost —Figures have been given in previous chapters of the cost of light railways in various countries, and they need not

The estimates (the amount of which

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room for reduction in the cost

dangerous things, but, ba ing

as the writer could obtain, he

wagons off the main line with which it is connected, there will be a saving in rolling stock. If a narrower gauge is adopted, separate stock is, of course, absolutely nece ary with separate repairing shops, etc, while if, with a view to obviating the difficulties and inconvenience of transhipment as much as possible, narrow gauge bodies are transferred to standard gauge frames, this not only means the provision of additional stock of special design but also the provision of pecial plant for lifting and placing the body. The subject of Rolling Stock is dealt with in greater detail in Chapter XIV.

Instructions for a Light Line.—The following instructions, laid down by the Government of India in Feb 1898, for the preparation of the project of the proposed Nowshera Dargai 2 ft gauge line, illustrate very well the principal points to be observed in keeping down the cost of a light railway :—

"(i.) Estimates to be prepared for a line starting from the left bank of the Cabul river.

An estimate for bridging that river is not required.

(ii.) Land for a 2 ft 0 in gauge is to be estimated for.

(iii.) All culverts to be built of dry stone, or stoneware pipes or ft bents.

(iv.)

(v.)

(b) Alternative estimates for permanent way to be prepared, providing (1) for new 25 lb steel rails and steel sleepers, and (2) for old iron rails and wooden sleepers.

(vi.) Stations and buildings to be sheds only, built of rail uprights, etc, and roofed with corrugated iron sheets.

No platforms are required.

(vii.) Locomotives of the Darjeeling Himalayan Railway latest type, as noted in the margin, to be provided for.

'B class'—Haul on level 840 tons.
Incline 1 in 100 210 tons.
Incline 1 in 26 50 tons.
Round curve of 60 ft radius.
Fuel 39 lbs coal per mile (average up and down).
Water, 45 gallons per mile.
Wheels 4 coupled, 2 6" diameter.

Under rolling stock, provision to be made for open trucks on d steel type 00 tons,

of light railways. Average figures are dangerous things, but, basing them on such meagre information as the writer could obtain, he

[illegible] the reader as an example of [illegible]

[illegible]	£980
[illegible]	224
[illegible] fences, etc	230
[illegible]	352
[illegible]	113
[illegible]	32
[illegible] at level-crossings,	40
[illegible]	1354
[illegible] way,	216
[illegible] way for sidings, etc ,	874
[illegible] lings,	242
[illegible] walls, parapets, etc ,	3
[illegible] eies,	340
[illegible] t per mile,	£5000

[illegible] works and land and buildings are costly items in this list [illegible] not to be contented until we are able to regard £4000 per [illegible]

[illegible] make [illegible] It [illegible] the [illegible] light lines lies within the powers of the Prefect The Western of France * German lines, Swedish State railways Danish State light railways and the Milan Northern of Italy average a working speed of from 22 to 25 miles an hour On the last-named, it is reported [illegible]

On Belgian light railways the maximum speed appears to be 18[illegible] miles an hour in the country and 6 in towns and villages

In England 8 miles an hour is the maximum speed permitted on tramways, and 4 miles an hour over facing points etc On the Wisbech and Upwell line the gradients are very easy, but with the view of keeping within the maximum speed permissible, the Westinghouse brake is made to act automatically when the speed exceeds 10 miles an hour Reference is made to this brake in Chapter XV The maximum speed prescribed for light railways in the Regulation of Railways Act, 1868, was 25 miles an hour, and it

* 'Relaxation of Normal Requirements for Light Railways' by P W Meik — *International Railway Congress Bulletin* 1895

is unlikely that the Light Railway Commissioners will allow this limit to be exceeded in any case. There might be a limit of 15 or less on public roads, and to 8 or less in streets, according to the circumstances of traffic. At level crossings, where no watchman is provided, on curves of less radius than 10 chains, on gradients steeper than 1 in 50, and over facing points not interlocked, a speed of 10 miles an hour might be prescribed—possibly less.

On ordinary English railways under the Regulation of Railways Act of 1889, all trains carrying passengers and all vehicles of such trains, whether carrying passengers or not, must be provided with continuous and automatic brakes. Such an order would only be enforced on a light railway where exceptionally high speed was permitted, or very heavy gradients occurred. In India for many years our passenger and mixed trains were worked with hand brakes on the engines (in addition to the steam brake) and in the brake vans, of which, on heavy trains, there would be two manned by the first and second guards, or by a guard in the rear van and brakesman in the other. On Belgian light railways continuous brakes are in some cases fitted on the locomotives, wagons, and coaches; in others screw brakes are considered to be sufficient. The "Société Générale des Chemins de Fer Economiques" of France are of opinion that, where the traffic and gradients are such as render it necessary to employ two brakesmen, continuous brakes should be adopted, but that, in other cases, the screw brake is better on vehicles, and a steam brake—in addition to the screw brake—on engines.*

In determining the brake power required, very short stretches of incline steeper than the otherwise ruling gradient may generally be neglected. It must not be forgotten that brakes will sometimes be required not so much for the safe working of the train on gradients as in order to pull up or reduce speed and thus prevent collision with foot or cart traffic.

On gradients not exceeding 1 in 100 one vehicle in trains provided with a manned or automatic brake would probably be considered sufficient, and one—or, on goods trains, even two—vehicles might, in order to avoid delay, be attached in rear of that braked vehicle.

Where steeper gradients than 1 in 100 occur, sufficient brake power will in each case have to be provided [illegible]

[illegible] train weight recommended, on a [illegible] cent of gross train weight recommended by the "Union des Chemins de Fer Allemands," is quoted in the form of a table, and Mr C. E. Hodson (Director of Construction, Railway Branch, P.W.D., India) has kindly furnished the writer with a

* Plocq on "Brakes"—*Bull. de la Comm. Internat. du Cong. des Chemins de Fer*, vol. viii., 1894.

ventures to place the following before the reader as an example of what might be —

Earth works,	£980
Bridges for public roads,	224
Accommodation bridges, etc,	230
Viaducts, etc,	352
Culverts, etc,	113
Metalling of roads,	32
[illegible]	40
[illegible]	1354
[illegible]	216
Land and buildings,	874
Stations,	242
Retaining walls, parapets, etc,	3
Contingencies,	340
Total cost per mile,	£5000

Earth works and land and buildings are costly items in this list [illegible] £4000 per

[illegible] m to make the most effective difference between standard and light railways It certainly opens the way, as we reduce the speed, for securing the utmost economy in construction and working

In France, as we have seen, the regulation of the speed on light lines lies within the powers of the Prefect The Western of France,* German lines, Swedish State railways, Danish State light railways, and the Milan Northern of Italy average a working speed of from 22 to 25 miles an hour On the last named, it is reported that occasionally they work up to 40 miles an hour Some secondary lines in France work at 30 and 35 miles an hour All these railways are satisfied that their ordinary working speed cannot be described as dangerous, although the Danish, German, and Italian lines referred to are not fenced, and the French lines are unfenced in the country On Belgian light railways the maximum speed appears to be 18$\frac{3}{4}$ miles an hour in the country and 6 in towns and villages

In England 8 miles an hour is the maximum speed permitted on tramways, and 4 miles an hour over facing points, etc On the Wisbech and Upwell line the gradients are very easy, but, with the view of keeping within the maximum speed permissible, the Westinghouse brake is made to act automatically when the speed exceeds 10 miles an hour Reference is made to this brake in Chapter XV The maximum speed prescribed for light railways in the Regulation of Railways Act, 1868, was 25 miles an hour, and it

* "Relaxation of Normal Requirements for Light Railways" by P W Meik,—*International Railway Congress Bulletin* 1895

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On ordinary English railways, under the Regulation of Railways Act of 1889, all trains carrying passengers, and all vehicles of such *trains, whether carrying passengers or not, must be provided with* continuous automatic brakes Such an order would only be enforced on a light railway where exceptionally high speed was permitted, or very heavy gradients occurred In India, for many years our passenger and mixed trains were worked with hand brakes on the engine (in addition to the steam brake) and in the brake vans, of which, on heavy trains, there would be two, manned by the first and second guards, or by a guard in the rear van and brakesman in the other On Belgian light railways continuous brakes are in some cases fitted on the locomotives, wagons, and coaches, in others, screw brakes are considered to be sufficient The "Société Generale des Chemins de Fer Economiques" of France are of opinion that, where the loads and gradients are such as render it necessary to employ two brakesmen, continuous brakes should be adopted, but that, in other cases, the screw brake is better on vehicles, and a steam brake—in addition to the screw brake—on engines *

In determining the brake power required, very short stretches of incline steeper than the otherwise ruling gradient may generally be neglected It must not be forgotten that brakes will sometimes be required not so much for the safe working of the train on gradients as in order to pull up or reduce speed and thus prevent collision with foot or cart traffic

On gradients not exceeding 1 in 100 one vehicle in rear provided with a manned or automatic brake would probably be considered

in rear, to stop any portion of a train breaking away during the ascent of the heaviest gradient On gradients of 1 in 40, and steeper, the

ke power per
gradients, by
in the form

of a table, and Mr C E Hodson (Director of Construction, Railway Branch, P W D, India) has kindly furnished the writer with a

* Plocq on 'Brakes —*Bull de la Comm Internat. du Cong des Chemins de Fer*, vol viii, 1894

useful note on this subject, together with the table which embodies his results —

"1 The brake power necessary for the safe working of steep inclines is required for two distinct functions, viz —

(a) To ensure efficient control of the train when *descending* the incline, i e, to check excessive speed over it, and to enable the driver to stop the train altogether within a reasonable distance, when required

(b) To ensure that, in the event of the breaking of a coupling in the train when *ascending* the incline, sufficient brake power shall be at once applied, either automatically or by hand, to prevent the rear portion of the train running back down the incline

"2 Obviously a portion of the brakes required for the *first* function need not be either automatic or manned, but may be weighted or pinned down, if the gradients are tolerably uniform, or, if stoppages are permissible, at convenient places where the grades change But for the *second* function none of the brakes can be pinned down, but all must be capable of immediate application when necessity arises, i e, they must all be either manned or else arranged to act automatically

"3 Let—

$\pm\frac{1}{I} = \pm i$ = the fraction representing the gradient,

and let it be $\left\{\begin{array}{l} +, \text{ if the gradient is ascending,} \\ -, \text{ if the gradient is descending} \end{array}\right.$

$\frac{1}{R} = r$ = the ratio of the resistance to motion on the level, at the given speed, to the gross weight of the train or portion thereof, under consideration

$\frac{1}{F} = f$ = the coefficient of friction due to the brake, i e, the ratio of the retardation due to a fully braked vehicle to the weight of the vehicle

$\frac{1}{B} = b$ = the ratio of the weight of the portion of the train (including engine and tender) which is braked to that of the whole train.

$\left.\begin{array}{l} V = \text{the speed in miles per hour,} \\ v = \text{,, ,, feet per second,} \end{array}\right\} v = \frac{22}{15}V.$

H = the "velocity head" in feet, due to speed of the train $= \frac{v^2}{2g} = \frac{V^2}{30}$, neglecting the rotative energy of the wheels,

$-\frac{\;}{2s}$ approx., including the rotative energy of the wheels

D = the distance within which the train may be brought to a stop

Then, generally,—

$$\frac{H}{D} = \frac{1}{K} + \frac{1}{BF} \pm \frac{1}{I}$$

$$= r + b f \pm i$$

$$b = \frac{\frac{H}{D} - (r \pm i)}{f}$$

"4 In order to calculate the proportion of brake power necessary to fulfil the *first* function, it is necessary to decide on one or other of the two conditions for work on the level, viz —

(*a*) The distance in which a train moving at a given speed ought to be stopped

(*b*) The proportion of the weight of a train which if braked is considered to give sufficient control on the level, let this be b_0

The relation between these two is

$$\frac{H}{D} = r + b_0 f$$

on the level.

Substituting this in the equation for the grade—for, presumably, the ratio $\frac{H}{D}$ (which expresses the relation between the speed and the distance of stop) should be the same on the grade as on the level,—we have—

$$r + b_0 f = r + b f - i$$

$$(b_1 - b_0) f = i$$

$$b_1 = b_0 + \frac{i}{f}$$

$$= \frac{\frac{H}{D} - r}{f} + \frac{i}{f}$$

$$= \left(\frac{H}{D} + i - r\right)\frac{1}{f}$$

Of this, the quantity $\frac{i}{f}$ may if desired, consist of weighted or pinned down brakes, leaving only $b_0 = \frac{\frac{H}{D} - r}{f}$ to be applied automatically or by hand, when necessity arises

"5. The minimum of brake power necessary to fulfil the *second* function is that which will just counteract the force of gravity on the incline, i.e.—

$$0 \overline{<} r + b_2 f + i$$

$$b \overline{<} \frac{i - r}{f}$$

This proportion must, as stated above, consist entirely of either manned or automatic brakes, and it must be maintained for every section of the train which is likely to break away from the leading engine, i.e., the weight of the leading engine must be excluded from it, though that of any engines pushing at the rear end of the train, when ascending the grade, may be included in it.

"6. In order to use the above formulæ, it is necessary to assume values for the constants r and f. Of these, r may vary from 5 to 25 lbs. per ton, and depends principally upon the style and condition of rolling stock and upon the proportion of the weight of the engine to that of the weight of the train. Its exact value is, however, of small importance on steep gradients; so, probably, $r = 0.003$ is near enough for practical purposes.

good gear, it may be as high as 400 lbs. per ton, but in slippery weather may be 100 lbs., or even less. Rankine* gives $f = 0{\cdot}14$, and probably this is near enough for ordinary conditions, provided the proportions resulting from it are not cut down too fine.

"8. The value of $\frac{H}{D}$ must also be fixed, and probably may be taken as $= \frac{1}{42}$ for light railways in England. This gives 50 yards for stopping at 10 miles an hour, 200 yards at 20 miles, and 450 yards at 30 miles an hour, which ought to be sufficient under usual conditions.

"9. Taking these data, the formulæ become—

$$D = \frac{3}{2} V$$

$$b_0 = \frac{\frac{1}{42} - \frac{1}{300}}{0.14} = 0.148 - \frac{1}{7} \text{ nearly}$$

$$b_1 = 0.148 + \frac{i}{0.14} = \frac{2 + 100i}{14}$$

$$b_2 \overline{>} \frac{i - 0.003}{0.14} = \frac{100i}{14} \quad \text{nearly}$$

* Rankine's *Civil Engineering*, 1894, art. 110.

"10 From these we get the following *minimum* proportion of brake power required for various grades, viz —

Gradient		$b_2 \quad \frac{100\,i}{14}$		$b_1 = \frac{2+100\,i}{14}$	
$\frac{1}{G}$	Per Cent 100 i	All manned or automatic and exclusive of the leading engine		of which a quantity = b_2 may be pinned down This proportion includes the engine	
Level	0	0	0 0000	$\frac{1}{7}$ =	0 143
1 in 200	0 5	$\frac{1}{28}$ =	0 0357	$\frac{5}{28}$ =	179
1 in 108	1 0	$\frac{1}{14}$ =	714	$\frac{3}{14}$ =	214
1 in 66 7	1 5	$\frac{3}{28}$ =	1071	$\frac{1}{4}$ =	250
1 in 50	2 0	$\frac{1}{7}$ =	1429	$\frac{2}{7}$ =	286
1 in 40	2 5	$\frac{5}{28}$ =	1728	$\frac{9}{28}$ =	321
1 in 33 3	3 0	$\frac{3}{14}$ =	2143	$\frac{5}{14}$ =	357
1 in 28 6	3 5	$\frac{1}{4}$ =	2500	$\frac{11}{28}$ =	393
1 in 25	4 0	$\frac{2}{7}$ =	2859	$\frac{3}{7}$ =	428
1 in 22 6	4 5	$\frac{9}{28}$ =	3214	$\frac{13}{28}$ =	464
1 in 20	5 0	$\frac{5}{14}$ =	3571	$\frac{1}{2}$ =	500

"11 *Of course such formulæ must be used with due regard to varying circumstances* They might easily be put in the form of a diagram"

There are several systems of working single line traffic, *e g* —

- Only one engine in steam, or two or more coupled together, on the line at the same time,
- Train porter or guard pilot,
- Train staff,
- Train staff and ticket,
- Electric tablet or staff,
- Block telegraph (sometimes admitting a second train into a section under the "permissive block" system),
- The Highland Railway system, no train being allowed to cross another or pass another otherwise than as prescribed in the time-table, except under telegraphed instructions from headquarters,
- The line clear and caution message

The staff system gives rise to considerable trouble and delay, if there is a break-down The electric staff or tablet is also expensive, requiring a separate wire and special instruments, besides the wire and instruments used for ordinary telegraph purposes

The line clear and caution message system is very common in India A telegraph wire from one station to another, and ordinary talking instruments at each station are used After the signaller has ascertained that the line between his station and the next is clear, a line-clear certificate or permission to proceed to the next station is issued to the driver On railways where caution messages are permitted, it having been ascertained that the line is occupied only by a train running in advance, a caution certificate allowing the driver to follow on with caution, after a certain interval, may be issued

the traffic economically on light railways It is not usually permitted on standard railways, and only under certain conditions The engine, tender, and passenger vehicles must be provided with continuous brakes, the goods wagons must be placed behind the passenger vehicles, with one brake van for every 10 wagons, the mixed train must not consist of more than 25 vehicles of all descriptions, the maximum average speed between stations shall not exceed 25 miles an hour, and mixed trains must stop at all stations *

Gauge appears to have no necessary connection with economy in the consumption of fuel During the year 1896 the following was the consumption stated in terms of Giridih (Kurhurbaree) best steam coal, on certain Indian railways —

Standard Gauge	lbs per train mile	lbs per 1000 gross ton miles
East Indian	60 93	165 59
North Western,	41 89	132 97
Oudh and Rohilkhund	39 66	128 43
Eastern Bengal State,	48 01	155 56
Metre Gauge		
Bengal and North Western	28 40	133 88
Rajputana Malwa,	35 42	169 23
Southern Mahratta,	32 55	187 64
Assam Bengal,	37 59	213 71
Eastern Bengal, Dacca Section,	32 65	231 15
Jodhpore Section,	27 83	148 45
Bickaneer Section,	26 91	150 48

* Orders made by the Board of Trade under the *Regulation of Railways Act*, 1889

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heavier, the expense is less because the coal is cheaper Every one knows how rapidly the cost of coal increases with the distance it has to be brought from the mines the average cost of coal on the East Indian Railway is only Rs 1 91 per ton on the Bombay, Baroda, and Central India, on the North Western, and on the Madras railways it is more than Rs 15 and there is a corresponding difference in the working expenses With a home supply of fuel, good traffic, efficient maintenance of way and rolling stock and favourable grades,

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Railways in England and Wales, Scotland, and Ireland,	2s 10d	per train mile
Easingwold Railway,	1s $4\frac{3}{4}$d	,, ,,
Southwold Railway,	2s $5\frac{3}{4}$d	,,
Indian standard gauge,	2s $9\frac{1}{2}$d	,, ,,
Indian metre gauge,	1s 11d	,, ,,
Indian special gauges,	*1s $10\frac{1}{2}$d*	,, ,,
Caen to Dives and Luc sur Mer, France, 2 ft gauge, in 1895	1s 4d	,, ,,
Cape Government railways, 3 ft 6 in gauge, in 1897,	4s 3 3d	,, ,,

The Indian standard gauge railways include a considerable mileage of military, as distinguished from commercial lines

The average cost of hauling for one mile one passenger unit is as low as 0 69 pie or 0 057d on the East Indian Railway, and as much as 1 51 pie or 0 126d on the Indian Midland, that of hauling 1 ton of goods is no more than 1 63 pie or 0 136d on the East Indian, while it comes to 4 12 pies or 0 343d on the Indian Midland, both being standard gauge lines. The metre gauge figures vary even more widely the cost of hauling a ton of goods is generally higher, pies or $\frac{1}{2}$d

gross earnings of Indian lard gauge, 50 56 on the metre, and 54 80 on the special gauges On all the railways in the *United Kingdom it was 56, on the Scottish railways separately it* was 51, and on the Irish railways 55

Good management and bad statistics sometimes go together Few and fully loaded trains will give a comparatively high figure of cost per train mile Putting on an extra train, for which there is a distinct demand in the interests of the public, will add to the cost per ton mile Statistics based on train mileage—being a measure of

necessary work done to satisfy public demands—are likely to be preferred in England Statistics based on ton mileage will be more favourable to the conditions prevailing in America or India The most careful economy cannot procure a low percentage of working expenses on receipts, if the traffic is poor and the lead is short

Very great assistance and encouragement may be given to light railways by the great companies to which they contribute traffic. Junction facilities may be freely granted The carriage of material for revenue, as well as construction purposes, may be charged at home line rates The cost of additional works at junction stations should be f dis-
pos orne
by in
crea ight
line should be carried out in the workshops of the main line at cost price The division of earnings may be in proportion to capital cost, if the main line works the branch When the light railway contributes traffic which has a long lead on the main line, earnings should not merely be divided on a mileage basis, the branch bears more than its share of the working expenses in that case, and should be awarded profits in the same proportion

If a light line is constructed by the State or others and leased to a company, the terms of remuneration to the latter should be such as to make the company work the railway in the interests of the public, and by doing so increase its own profits The formulæ proposed by French and Belgian experts have been discussed at some length in Chapters III and IV The terms on which a main line company offers to work a feeder light railway generally assume a much more simple form Thus, the North Western Railway of India has named certain branches which, if made, it would probably be able to work for about 55 per cent of the gross receipts

One important point in economical working must not be forgotten —the reduction of the station and train staff to a minimum Every official on a light railway should be ready to do anything that may reasonably be required of him The duties of the *employes* should be interchangeable The economies thus effected on the Easingwold Railway have been described in detail. Others have been pointed out with reference to Continental light railways Clerical work should be cut down as much as possible

CHAPTER XIV

LOCOMOTIVES AND ROLLING STOCK

CONTENTS —Electricity as a motive power—Various systems of applying it—Telpherage— Electrical traction on steep gradients—Electrical traction in Eng [illegible]

Dimensions of rolling stock—Four or six wheels coupled tank engines—Adhesion tractive and hauling power of locomotives—Goods stock—Passenger stock—Belgian light railways stock—Decauville stock—Eastern Bengal State railway stock on three gauges Barsi light railway stock

Electrical Traction —Our choice of motive power on light railways lies practically between steam and electricity The claims of the latter deserve particular consideration when the service to be provided is a regular and frequent one of comparatively light trains carrying passengers For an almost continuous traffic of this sort, with loads which vary little from the average, electricity is eminently suitable, demanding no very great expenditure on generating plant and mains to begin with, and offering a fair prospect of economy in working, while every addition to such a service would, if steam were adopted, call for an increased number of locomotives, and an increased expenditure on fuel and other running requirements In tunnels the difficulties of ventilation would be largely minimised by electrical traction, and in the streets of towns—where the noise, smoke, dust and smell, due to the use of steam, are especially objectionable—electricity has obvious advantages Although, therefore, steam locomotives may long continue to be regarded as the most economical and practical movers of irregular and intermittent traffic of the usual kind in the open country, they have less opportunity of exhibiting their speed and power in the neighbourhood of ordinary street or road traffic, and more and more shall we see them displaced by electric motors on our underground railways and the lines which serve our cities and suburbs.

The dynamo electric machine was known, first of all, as a means of producing electrical energy by an expenditure of mechanical work.

When it was also recognised that its function could be reversed, and that it could act as a motor to perform mechanical work when supplied with energy in an electrical form, its applicability to purposes of railway traction began to be determined Electrical traction* may be applied in several forms —

I Storage batteries may be employed to drive the motor, the batteries and motors being carried—

(a) in the car, which is to be preferred as more economical, if space is available, or—

(b) on a separate locomotive

II Various conductor systems are more commonly adopted—

(a) Ordinary rails may be used as conductors, but are unsuitable to urban lines where the rails lie flush with the surface of the road,

(b) Nor is the use of a third insulated rail—laid in the centre of the track—above ground suitable in such cases

(c) Overhead conductors—either the wire and trolley arrangement, or slotted tubes and contact carriages in the form of pistons sliding in the tubes—and for light railway purposes, the wire and trolley system is pre eminently suitable and economical

(d) Underground conductors in a slotted channel or conduit are less suitable to street or road work, and are much more expensive

(e) Messrs Ayrton and Perry devised a system, by which the line was divided into short sections, each having an exposed conductor—it might be one of the rails—placed, as the train passed over it, in temporary contact with a well insulated conductor in a closed underground channel by means of automatic electro-magnetic switches Leakage was thus reduced to a minimum

Another method of electrical locomotion, known as "telpherage," was proposed by the late Prof Fleeming Jenkin, and developed by him in conjunction with Messrs Ayrton and Perry It was intended for the slow carriage of goods in localities where the traffic was not enough to pay an ordinary railway, and has been tried in Japan and some of our own colonies The line itself is singular, consisting of a steel rod or cable, suspended from brackets fixed to posts erected about 70 ft apart This rod or cable is not only a carrier of trains, but a conductor of the motive power—electricity If the "telpher" line

be carried at higher speed Gener-
trains are run slowly, but, if the
in an almost continuous stream

The train consists of a series of buckets or skips, hung from a single wheel or a pair of wheels, and they are spaced by wooden bars The locomotive is formed by a small electric motor hanging below the line, and connected by spur and chain gearing with a pair of driving wheels In general, the line is electrically divided into sections of nearly the same length as that of a train The train is furnished with a continuous conductor from end to end, through

* *Encyclopædia Britannica*, "Traction"

which it makes electric contact between the section in front and that behind, and the motor is included in the circuit of this conductor

The ease and rapidity with which electrically moved cars can be stopped or started even on steep inclines—a cruel strain on horses—render them singularly suitable for tramway purposes Their speed can be checked or graduated to meet any requirement or emergency Far steeper gradients can be faced on such lines than on other adhesion railways, owing to the reduced dead weight of the motive apparatus, and the gain in tractive power where motor cars are used, so that in America* short gradients of 12 per cent are not unknown, while gradients of 8 per cent are common The steep line from Florence to Fiesole, which may be known to the reader, is worked by motor-cars weighing 7 5 tons, with a tractive force of one fifth of this weight, or 1 5 tons The locomotives of the City and South London Electrical Railway (which the writer had the privilege of visiting shortly after its being opened), in hauling—including their own weight—as much as 30 tons up a gradient of 1 in 14 with sharp curves, develop tractive energy equal to a coefficient of adhesion of one fourth, such as must be expected, observed Dr Preller,† from a good electrical locomotive, as compared with a coefficient of adhesion of only one-sixth or one seventh in the case of steam locomotives

It is very remarkable that this application of electricity has hitherto in England been almost entirely confined to such special and important works as the City and South London Railway, the Liverpool Overhead Railway, the Waterloo and City Railway, and the deep level lines which are now being carried under the crowded thoroughfares of London

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in parallel Two of the feeders are connected to the working conductors at Great Dover Street Station, 12,800 ft. distant The other two are coupled in parallel to Stockwell and one is continued to the Oval, where it is connected to working conductors, 14,330 ft from the generator station The cables consist of a stranded core of 61–14 B W G, insulated and sheathed with lead They are carried along the tunnels on bracket supports The working conductors consist of channel steel laid between the rails, and carried on glass insulators fixed to alternate sleepers. Each locomotive is provided with three collectors The return circuit is through the uninsulated rails The

* *Min Proc Inst C E*, vol cxxv, "The Limiting Gradients on Adhesion Tramways," by E Denizet For Abs.

† *Min Proc Inst C E*, vol cxii, "Hopkinson on Electrical Railways," 14th Feb 1893

armatures of the motors are built directly upon the axles of the locomotives, while the magnets are supported partly on the axle and partly on the frame By thus adopting the principle of direct driving, the necessity of gear of any description is done away with, and the mechanism is, therefore, as simple as possible There are two direct acting motors on each locomotive, each motor capable of developing 50 h p at 25 miles an hour

The locomotives for the Central London Underground Railway* are built by the General Electric Company at Schenectady, U S A, in accordance with the specification of the British Thomson Houston Company The tunnels have a bore 11 ft 6 in in diameter The lines are carefully graded for starting and stopping with the assistance of a series of comparatively steep descents and ascents from and into stations Trains of seven carriages will afford seating accommodation for 336 passengers, and weigh 105 tons loaded, exclusive of the loco-

Distance between wheel centres of each truck	5 ft 8 in and 6 ft
Distance between two truck centres,	14 ft 8 in and 14 ft
No of wheels, all driving,	8
Diameter of wheels,	42 in
Total wheel base	20 ft 4 in and 20 ft
length of locomotive,	20 ft 8 in and 28 ft
height	9 ft 4½ in and 9 ft 8½ in
Weight of each wheel,	about 5 tons
Total weight of locomotive,	24 tons
Maximum draw bar pull required at starting,	14,000 lbs
Draw bar pull running at 22 miles per hour,	8 000 lbs
Weight of each motor frame complete, with field coils in place,	6,500 lbs
Weight of the armature complete, with sleeve and conductor,	2,500 lbs
Total weight of motor,	12 000 lbs

On the Liverpool Overhead Railway motor carriages are used, and Mr Greathead admitted that, if there was head room and the motors could be placed under the carriages, and if the trains were short, motor carriages were to be preferred, because the weight hauled was reduced and terminal shunting avoided On the City and South London, however, there was no room for the motors under the

* *Street Railway Journal* (International Edition) March 1898

carriages being
vehicles in any
re provided

The economy of the motor-car, as compared with haulage by a separate locomotive, may be illustrated by Mr W Baxter's analysis* of the weights in two given cases He takes a five car train and gives the following figures —

	Tons		Tons
5 passenger cars,	162 50	5 cars,	162 50
Steam locomotive,	85 00	Electric motors,	22 00
105 passengers,	6 36	105 passengers,	6 36
	253 86		190 86

In the latter case the weight of the motors is not more than 11 5 per cent. of the weight of the train, while the weight of the whole train is also reduced by 25 per cent, with a corresponding saving in driving power

country The use of accumulators, of the present types, has proved to be commercially a failure, owing to the high cost of maintenance, while underground conductors, on the culvert and slot system, are rarely adopted, on account of the heavy expense—amounting to as much as £1500 to £2000 per mile—of their construction. Nor is the underground conduit generally accepted as a satisfactory solution of the question of electric traction in our streets, because of the width of the slot, although at Buda Pesth this is made as narrow as three quarters of an inch. A better solution, it has been suggested, is to be found in another example, that of an electric railway in Paris on the Claret Vuilleumier system† of conveyance by underground conductors, which was brought forward when the accumulator system had been proved to be a failure The current for the motors is collected by brushes fixed underneath the cars and pressing on a rail flush with the surface of the ground, the track serving as a return This rail is in sections, each a little shorter than a car, and each group of 18 sections is connected by rubber cables to an automatic apparatus called a "distributor," which is the feature of the system The sections of each group are successively excited by the distributor as the car passes over them, those not covered by a car being insulated A spare distributor is carried by each car, and can be substituted for a faulty one in a few minutes To prevent horses from slipping, the conducting rail is made up of metallic blocks, eight feet apart,

* *Min Proc Inst C E*, vol cxxvi, "Electric Transportation," by W Baxter, jun For Abs, 1896

† *Min Proc Inst C E*, vol cxxvi, "Electric Tramway in Paris" by Ch Jacquin For Abs, 1896

embedded and insulated in bitumen, and connected in pairs by a cable below the surface Each collector, therefore, which is formed of an iron band pressed down by springs, must be more than eight feet long Public lighting by arc lamps, along the city portion of their line, is also carried out by the tramway company This method of picking up the current from a series of contacts placed in the surface of the road is not altogether free from chance of accident, for last year* two horses were killed by treading on one of the blocks, which somehow remained electrically "alive" after the passage of the car, but it appears to be less expensive than the culvert and slot conductor and more suitable for electrical lines in crowded thoroughfares

In the Belt line tunnel, Baltimore, U S A —where electric locomotives are, for facilitating ventilation, employed to haul the trains, steam locomotives included—the current is conveyed to the motors by an overhead line 17 to 22 ft above rail level The conductor consists of an iron trough formed of two Z bars and a cover plate, there being *a slot one inch wide between the bars to admit of a brass shoe travel*

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driving wheels, and weigh 95 tons each

That, however, is a special illustration of electrical traction being applied in the tunnel of a great railway It is to the overhead wire, so successfully and universally adopted in America, that we must look for a sufficiently economical method of applying electric power to light railways The almost universal system in the States is that of a motor car from which a trolley wheel is projected to run along the under side of a suspended wire which receives its current from a generator station

We have heard a great deal about unsightly poles and wires, but there seems to be no reason why they should be hideous, and it is difficult to discover any reasonable objection to their erection in our broader suburban streets, on our district roads or in the open country Of this type we had, until recently, but two examples in England, the Leeds and the South Staffordshire Tramways, but already there are signs of progress in this direction, and a proposal has lately been put forward to connect the tramways of Leeds and Bradford by a light railway, the cars to be propelled by electricity, and the trolley arrangement with overhead wires to be adopted It has been far otherwise in America In the United States there were 5851 motor-cars and 3532 miles of electrically worked lines in 1892, 40,000 motor-cars and 10 363 miles of line in 1896, and the mileage of such lines must now be much more than 15 000, a great number of them being what would be called in England light railways, running from point to point, and sometimes on public roads

* *Saturday Review* 29th May 1897, "The Progress of Electric Traction," by Silvanus P Thompson

There are many reasons for this extraordinary development of electrical tramways in America, while horse traction has so persistently survived in England. A bus or cab can pull up for us close to the kerbstone; our streets, paved with wood or asphalt, offer little more resistance to the horses that draw our cabs and busses than would rails, while they are generally too narrow or too crowded to admit of even a partial occupation of a fixed track by a certain class of vehicles, for the conditions of our street traffic demand the free movement within a limited space of innumerable units among one another. In the United States, on the other hand, the road surface is not favourable to the use of busses or cabs, and carts and private buggies run most easily within the tram track; the inhabitants of the cities are essentially a car-riding people, and the tram lines are frequently laid down as a matter of pioneer speculation, and the streets are laid out and built to accommodate them.

Attention has already been drawn to the ease and celerity with which electric cars can be started or stopped, and their speed increased or decreased as emergencies may require, and to their remarkable suitability to a traffic which entails a uniform and continuous service with frequent halts. Thus on the Nantasket Beach line* the electric motor cars are able to make a run of 10·6 miles with sixteen stops in twenty-six minutes, to do so with such regularity that they connect with boats arriving at intervals of half an hour, and frequently to make way for regular steam trains on the main line of the Plymouth Division. When we consider that this leaves but four minutes at the terminus for unloading, running round the trail car, and loading, and wonder how such a constant and punctual service can be maintained, we are told that the reason why electricity can do this and steam cannot is found in the tremendous accelerating power of properly designed electric motors with rotary motion as compared with the reciprocal motion of ordinary locomotives.

It is to this propulsion by a continuous and uniform rotary movement, instead of the alternative movement of two pistons, that the smooth yet swift motion of the start effected by the Heilmann electric locomotive on the Western Railway of France is attributed. On a trial trip† a train of twelve carriages, weighing 150 tons, was hauled 37 miles at a speed of 18 miles an hour. It is stated that far higher speeds than this will ultimately be attained. The correspondent of *The Times*, who was present at the trial, was especially struck by the steady gliding movement of the start, in such marked contrast with the jerking on French railways. It reminded him of the English trains which are under way before the motion is felt. The

* *The Railway and Engineering Review*, Nov. 6, 1897.
† *Herapath's Railway Journal*, Nov. 19, 189[illegible]

frequent trains for passenger traffic is regarded with growing favour, the economy of motor freight cars is not so obvious, although every

heavy goods trains * a single steam locomotive of large power would be more economical than electrical traction In the latter case, the irregular distribution would demand a large capacity for the mains and for the generating stations if several were provided, while if only one station work
not be augmente
increased Gene
traffic steam is to be preferred

To other motive power it is scarcely necessary to allude A horse may haul as little as 1½ tons on an ordinary road, or as much as 9 tons on rails, but in the case of the latter the road would have to be made up between the rails, so that the use of horses would generally

largely adopted in the United States for ordinary street tramways,

here

convenienc will be
secured by branch
railway, as id other
lines Descriptions and illustrations of the special locomotives and

of building separate stock, upon the standard or any other gauge

The quantity of each kind of rolling stock required will depend upon the description and amount of traffic—minerals, general merchandise live stock passengers, etc —to be dealt with, upon the service of trains, and upon their composition In addition to engines actually running, we shall have some washing out, etc, in the engine sheds and others in the repairing shops Of the latter, of course, there will be few at first, but, in course of time, we may have as

* *Min Proc I st C E* vol cxxv The Substitution of Electricity for Steam in Railway Practice by Louis Duncan For Abs

STATISTICS OF ROLLING STOCK ON CERTAIN RAILWAYS

Details	All Railways in England and Wales, Scotland, and Ireland.	Light Railways authorised under the Tramways (Ireland) Acts, 1860 to 1883	Jodhpore Bickaneer (metre gauge) Railway, India	Dacca Section (metre gauge), Eastern Bengal State Railway India	Rajputana Malwa (metre gauge) Railway, India	Belgian Light Railways, 189[illegible]
Number of miles of line open in 1896	21 277	230	361	86	1,784	867
Total number of locomotives	18 9[illegible]6	42	17	12	441	2[illegible]3
" " passenger vehicles	58 983	127	69	67	1 316	710
" " goods and other vehicles	633,771	469	232	259	7,412	1 780
Number per mile of line open of locomotives	0 891	0 183	0 047	0 140	*0 239	0 292
" " passenger vehicles	2 772	0 552	0 190	0 780	*0 714	0 820
" " goods and other vehicles	2[illegible] 787	2 039	0 637	3 012	*1 020	2 053
Value per mile of line open of engine stock			Rs 1,025	Rs 3 077	Rs 1,498	
" " coaching and goods stock			" 1,707	" 5,704	" 7,521	
Total value of rolling stock per mile of line open			" 2,732	" 8,781	" 12,022	£633
" " for each rupee earned per mile per week			" 40 2	" 76 4	55 1	
Gross earnings per mean mile worked per week	£814	£4¾	" 68	" 115	" 218	

* Calculated on 1844 miles, including the Palanpur Deesa, the Gaekwar's Mehsâna and the Ooderpore Chitor railways

many as one third of our total number out of running or even 25 per cent in shed In regard have to deal with a frequent stock, and prompt unloading, reloading, and return of wagons, our stock will be less tied up and more fully utilised than if the traffic demands not more than one or two goods or mixed trains in each direction daily on a short line If our traffic be mainly mineral we shall have to be prepared with a considerable tonnage of special stock to carry such freight at low rates, for mixed goods of a higher class we shall have to provide a smaller

safe to base our estimate upon an average demand, for we may have to deal with much heavier traffic at certain seasons—on market days, during fairs, etc —and such an unequal distribution of service will oblige us to consider the maximum rather than the average Where so many factors determine our requirements, it is useless to attempt to measure them in terms of one, but—as was observed in the chapter on Belgian Light Railways—we are not surprised to find that the gross earnings and the cost per mile of rolling stock in the case of any railways which admit of comparison follow the same order Thus, in the table on page 237 it will be noticed that the gross earnings per mile per week being Rs 68 Rs 115 and Rs 218, the total cost of rolling stock per mile has been Rs.2732, Rs 8781, and Rs 12,022, on the Jodhpore Bickaneer on the Dacca section of the Eastern Bengal State Railway, and on the Rajputana Malwa Railway respectively The quantity of rolling stock on the Belgian Light Railways depends less upon the demands of a considerable traffic than upon the restricted use of the stock upon a system of short sections The conditions of traffic, however vary so much and the total effect of each of the different factors is so difficult to determine, that no useful rule or formula can be deduced from such figures, and the problem remains to be solved separately for any proposed line from a careful consideration of the probable traffic to be accommodated

and more to build their own stock but in many cases it may be desirable for traders and agriculturists to place their own trucks and wagons upon the light railway

For purposes of comparison the following table, containing a few of the standard dimensions and weights for rolling stock in India, may be useful —

STANDARD DIMENSIONS FOR LOCOMOTIVES AND ROLLING STOCK IN INDIA

		5 ft 6 in gauge		Metre gauge		2 ft 6 in gauge	2 ft gauge
		A	B	A	B		
Maximum width of stock over all	ft in	10 6	10 6	8 6	8 6	7 6	6 0
Maximum height above rail level	,,	13 6	13 6	11 0	11 0	10 0	9 0
Minimum width of seat per passenger	inches	19½	19½	19½	19½	19½	19½
Minimum floor area per passenger	sq ft	3½	3½	3½	3½	3½	3½
Minimum cubic capacity per passenger	cub ft	25	25	25	25	22	22
Maximum rigid wheel base for passenger vehicles	feet	22	16	15	12	12	10
Maximum rigid wheel base for goods vehicles	,,	16	14	12	10		
Maximum weight on a pair of wheels for locomotives	tons	15	15	8	8	6	6
Maximum weight on a pair of wheels for goods stock		12	12	7	7		
Maximum weight on a pair of wheels for coaching stock	,,	9	9	5	5	4	4
Maximum weight per foot run of wheel base for tank engines	,,	4	4	2·67	2·67		
Maximum weight per foot run of wheel base for engine and for its tender separately	,,	3	3	2·00	2·00		
Maximum weight per foot run over buffers for tank engines	,,	1·875	1·875	1·333	1·333		
Maximum weight per foot run over buffers for engine and its tender together	,,	1·625	1·625	1·125	1·125		
Maximum weight per foot run over buffers for goods stock	,,	1·200	1·200	0·800	0·800		
Maximum total gross weight for tank engine	,,		60		32		
Maximum total gross weight for engine and tender together	,,		86		46		
Standard diameter on the tread for all new carriage or wagon wheels	ft in	3 7	3 7	2 4	2 4		

A. Absolute for any railway for all new works   B Recommended for all except unimportant branches

The figures are given for the 5 ft 6 in, the metre, and special (2 ft 6 in and 2 ft) gauges. Three times the gauge may be regarded as the maximum width of stock over all, and this is permitted in the case of the 2 ft 6 in and 2 ft gauges If the weight in lbs per yard of rail were equal to six times the greatest load on a pair of wheels, we ought to have a 90 lb rail on the 5 ft 6 in gauge a 48 lb on the metre, and a 36 lb rail on the special gauges, but, in each case, if we reduce the axle load or reduce the speed, we may use a lighter rail For example, our 62 lb rails, which still carry ordinary trains on the 5 ft 6 in gauge at normal speed, are amply strong for light railways on the same gauge after years of service in the main line, and we may place upon them trains of ordinary goods and coaching vehicles from the main line, hauled by the lighter locomotives, at speeds of 15 to 20 miles an hour

5 ft 6 in and metre gauges —

INDIAN RAILWAYS

Standard Designs of Rolling Stock, approved by the Committee of Locomotive and Carriage Superintendents

	5 6	Metre
Coaching Stock—		
Figured width over sunshade board	10 6"	8 6
*Width outside body	9 0	7 9
Height inside,	7 9"	not less than 7 0
Height from rail to top of lamp cover,	13 3	11 0
Wheels diameter of (as scaled)	3 7"	2 3
Height of buffer centres	3 7½	1 11
Length of under frames	27 0	19 4
(bogie)		40 0
Goods Stock—		
Width outside angle irons	9 4⅜"	
inside sheeting	9 0	
Height inside	7 10½"	7 0
Height from rail to top of roof	12 0'	
Width outside sheeting		7 0
Wheels diameter of body of	3 2	2 0

* Compare English passenger carriages which may be 7 ft 6 in wide inside and American cars 9 ft or more both on the 4 ft 8½ in gauge

On light railways of short length, tank engines, carrying their own coal and water, will enable us to do without separate tenders Unless the haulage is heavy enough to require the coupling of six wheels, and more especially if the curves are so sharp as to make it necessary to limit the length of rigid wheel base as much as possible, a four wheels-coupled engine will be best, with a leading bogie or one free radial axle to steady it, and prevent that galloping action which short-based four wheeled vehicles, running at fair speed, inflict upon the track and the passengers. If the light railway runs on a high road or through the streets of a town, it may be necessary to case it in, so that the working parts may be covered and fire concealed from view It is often convenient to be able to work the engine from either end —the driver standing upon whichever platform happens to be in front—and the driver should not only be able to move freely from one part of his engine to another but foot boards and hand rails should be provided on every vehicle, so that there may be easy communication between the driver

end of the train to the other

to enter into details regarding the design of locomotives to suit many and varying

resistance—in pounds per ton of train—equal to $\frac{2240}{G}$, if $\frac{1}{G}$ be the rate of gradient The resistance is also considerably increased by head winds, side winds, curves, or roughness of road, in the case of curves, it will be affected by the length of wheel base

The adhesive force of locomotives per ton of load on the driving wheels, and on all wheels coupled to the driving wheels, is estimated at 450 lbs in ordinary English weather, it may be as high as 600 lbs on very dry rails, or as low as 200 lbs in frosty weather

If D = diameter of cylinder in inches,
P = mean pressure of steam in cylinders in lbs per sq in,
L = length of stroke in inches,
W = diameter of driving wheel in inches,
T = tractive power on rails in lbs,

the following formula is given by Molesworth* to determine the tractive force —

$$T = \frac{D^2PL}{W}$$

* *Molesworth's Pocket Book*

Q

If R^g = resistance due to gravity on the steepest gradient in lbs. per ton (see above),

R^r = resistance due to assumed velocity of train in lbs per ton,

T = tractive power of engine in lbs as found above,

W = weight of engine and tender in tons,

L = load the engine can take in tons, including the weight of the wagons, but not that of engine and tender,

we have the following formula for finding the load which an engine will take on a given incline —

$$L = \frac{T}{R^g + R^r} - W$$

If S = square feet of heating surface, and V = velocity in miles per hour, then T, the tractive force in lbs that may be developed in a locomotive $= 374 \frac{S}{V}$.

If D = diameter of cylinder in inches, the length of stroke may be about $1\frac{1}{2}$D, and
be about 60D
by the formula
the area of fire-grate = 013H

The quotation of these formulæ will, at any rate, give the ordinary reader some idea of the relative effect of the various dimensions which are given when describing locomotives It is obvious, for example, that—if we are satisfied with low speeds—we may increase the tractive power by decreasing the diameter of the driving wheels, that, if we increase the tractive power by increasing the diameter of the cylinder and the length of the stroke, we must also increase the heating surface and the area of the fire grate, and that we can haul heavier loads at low speeds

If the adoption of a narrower gauge deprives us of the use of the main line stock and forces us to build our own goods wagons, we shall probably find four wheel wagons most economical for a mixed traffic of comparatively small consignments A low ratio of dead to paying load and a maximum capacity of wagon space are important
of a few staple commodities in

should consist of as few types as
have no brakes which can be got
the train is in motion, except those on the engine and van, and the concentration of stopping power in the latter adds considerably to the non paying load to be hauled. The question of adopting some arrangement by which hand brakes on the loaded vehicles may be operated by the guard deserves consideration In India, and in tropical climates generally, the goods stock should be of iron, not wood

With passenger vehicles through communication from one end of the train to the other may be secured by a central longitudinal aisle dividing the transverse or longitudinal seats with foot plates covering the buffers and couplings, or else by foot boards and hand rails on the outside of the cars We may arrange the seats transversely, if preferred, but it will not be necessary, as in ordinary carriages, to carry cross partitions right up to the roof Indeed, the carriage may also, in a fine climate, be open at the sides, with awnings or tarpaulins which may be let down as a protection against sun or rain When the sides are closed in, and a longitudinal aisle is provided, the ends and intermediate partitions should have sliding doors, and a verandah and steps at each end of the carriage, so that passengers may conveniently enter and alight Both these types are adopted in India and on light railways on the Continent The passenger stock can be more fully and economically utilised if accommodation is restricted to only one, or, at the most, two classes of passengers The provision of three classes of compartments and of special smoking compartments of all three classes, and the reservation of compartments for ladies only, make it impossible to fill the carriages on the main lines uniformly, and increases the amount of dead weight hauled If old main line stock is available, we may be able to adapt it to light-railway purposes by removing the partitions, closing the side doors, and adding end doors opening on to end platforms and verandahs It appears to be usual on the Continent to allow the latter to be occupied by passengers as standing places The Western Railway of France has started "tram trains," consisting of two axled vehicles containing 75 passengers and luggage, on light lines forming part of its system, and four wheeled cars of this kind with short wheel bases may very well be used where the speeds are low.

The rolling stock in use on Belgian Light Railways has been briefly referred to in Chapter III, and the quantity and cost of different types have been given The engines manufactured by the Société St Leonard at Liége for these metre gauge lines* are, as previously stated, outside cylinder six wheels coupled engines, with frames outside the wheels to reduce the side sway As the engine has so short a total wheel base—over leading, centre, and trailing wheels—as 5 ft 10½ in, the end overhang is considerable The engine is cased in, as it is advisable to cover up the fire and working parts of locomotives plying on ordinary roads The main connecting rods are very long, as they are directly coupled to the crank pins of the rear axle on Hall's system,
overhang of the crank pins by
wheels The centre of gravit
buted as uniformly as possible over the coupled axles by means of compensation levers The grate is built for burning coal-dust briquettes The boiler is fed by Giffard injectors from water tanks

* *The Engineer*, May 1, 1896.

on both sides. The price of the engine is stated to be about 11 32d per pound of weight The following are the principal dimensions —

Diameter of cylinders,	11 in.
Stroke of pistons,	1 ft $2\frac{1}{8}$ in
Diameter of wheels,	2 ft $8\frac{3}{4}$ in.
Wheel base,	5 ft $10\frac{7}{8}$ in
Length of fire box,	3 ft $4\frac{7}{16}$ in
Width of fire box at top,	3 ft $0\frac{3}{4}$ in.
Width of fire box at bottom,	2 ft. $3\frac{11}{16}$ in
Height of fire box in front,	3 ft $7\frac{5}{16}$ in
Height of fire box at end,	3 ft 1 in.
Diameter of barrel	3 ft $4\frac{9}{16}$ in
Total length of boiler,	10 ft $4\frac{7}{8}$ in
Length of tubes between tube plates,	5 ft $2\frac{3}{4}$ in.
Diameter of tubes,	$1\frac{3}{8}$ in. to $1\frac{9}{16}$ in
Number of tubes,	160
Grate surface,	7 9 sq ft.
Heating surface of fire box,	44 65 sq ft
Heating surface of tubes, inside,	299 12 sq ft.
Total heating surface,	343 78 sq ft
Capacity of water tanks,	444 4 gallons
Capacity of coal bunkers,	1100 lbs.
[illegible]	15 tons, French
	$18\frac{1}{2}$ tons, French
	10 atmospheres
Theoretical tractive power,	7700 lbs
Effective tractive power at 60 per cent,	4620 lbs
Total length of engine to end of buffers,	20 ft $2\frac{7}{8}$ in
Outside width,	8 ft $0\frac{3}{4}$ in
Height from rail surface to top of chimney,	9 ft $11\frac{7}{16}$ in

Engines of similar type are also constructed by the Sociéte Métal[illegible] which supplies most of the vehicles [illegible] of 23 ft $10\frac{9}{16}$ in, and an outside [illegible] $7\frac{1}{4}$ in. The second-class cars have plain boarded cross-benches to seat twenty four inside, and afford standing room for sixteen more passengers on the two platforms. In the first-class the seats are cushioned, and in some compartments are arranged longitudinally on one side of the aisle, so that they may also be used as couches Both classes of cars have a longitudinal aisle (leaving seats for two on the transverse benches on one side, and for one on the other) and iron flaps covering the buffers and couplings, so that the conductor can pass from end to end of the train. Some of the cars are open at the sides, in which case end platforms are not provided. All the cars are four wheeled, with a wheel base of 7 ft $10\frac{7}{16}$ in Other dimensions and the cost have already been mentioned in Chapter III.

The same writer in *The Engineer*—observing in the first place

that the arrangement of two or more coupled axles, and a costly movable bogie with two free axles either in front or at the tail of the engine, is not altogether satisfactory on light railways, where tractive power is so much more important than speed, because the bogie absorbs so much of the weight of the engine, and, secondly, that locomotives fitted with one radial axle are not completely successful in adapting themselves to sharp curves, because they do not readily return to their normal position—draws attention to the system patented by Krauss & Co of Munich for forming the bogie out of one of the coupled axles, and of one free axle only In spite of their comparative lightness, these locomotives are said to take sharp curves steadily and easily without slacking speed, and to be largely used on main, secondary, and light railways

Reference has been made in Chapter IV to the rolling stock in use on a French light railway—from Caen to Dives and Luc sur Mer—constructed and equipped by the well known Decauville Company This line is a portable railway on the 2 ft gauge, and is an interesting example of the capacity of such stock All the passenger and *most of the goods vehicles are mounted on bogies A third class* carriage, weighing $3\frac{1}{2}$ tons, will carry fifty six passengers A bogie wagon, weighing $3\frac{1}{4}$ tons,

Full descriptions, giving

illustrations of rolling stoc

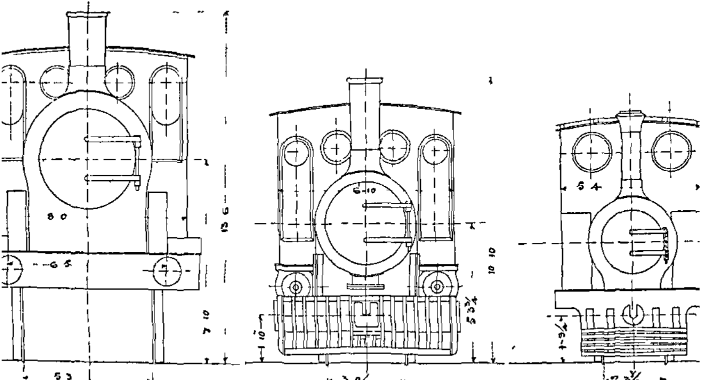
6 in, 2 ft, and narrower gauges, will be found in the lists of the Decauville Company and of Messrs John Fowler & Co

Having briefly reviewed the metre gauge rolling stock on Belgian Light Railways, and the 2 ft rolling stock on a French "Decauville" line, reference is to be made to Chapter XV for a descrip

physical difficulties in one part of the country and the other do not greatly differ, but, as the system is divided into sections by wide and shifting rivers which compel transhipment in any case, the principal objection to a change of gauge must in any case be reckoned with, and narrower gauges have been adopted where the traffic did not require lines of wider gauge and greater capacity The design of

comparison of the differences which follow the adoption of one gauge or another under normal conditions

The locomotives illustrated in fig 4 on page 246 and in Plate V are the D class four wheels coupled engine on the 5 ft. 6 in gauge, the F class six wheels coupled engine on the metre gauge, and the



"D" Class 5 ft 6 in Gauge "I" Class Metre Gauge 2 ft 6 in Gauge Engine

FIG. 4 —Front Elevations of Engines on the E B S R.

four wheels-coupled tank engine on the 2 ft 6 in gauge In addition to the details on the diagrams, the following dimensions may be quoted —

		5 ft 6 in	Metre	2 ft 6 in
Cylinders, diameter,	in	18	14	8½
„ Stroke,	in	26	20	12
Heating surface, tubes	sq ft	1157 61	590	210
„ „ Fire box,		124 49	59	29
„ „ Total,	„	1282 10	649	239
Fire grate area	„	22 04	12	5 18
Capacity, coal,	cub ft	235	120	20
„ water,	gallons	2500	1000	400

n the 5 ft 6 in gauge seats 60, 6 in gauge 32 passengers f the wagons (Plate VI) are as follows —

		5 ft 6 in	Metre	2 ft 6 in
		T cwt qr	T cwt qr	T cwt qr
Covered goods wagon	Tare,	8 0 0	4 17 0	3 9 0
	Load,	16 0 0	9 3 0	3 13 1
Low sided wagon	Tare,	6 14 0	2 18 0	2 3 0
	Load	11 6 0	5 19 0	4 19 3
		c ft.	c ft.	c ft.
Covered goods wagon, cub capacity,		1300 60	870 50	583 28
Low sided wagon, „ „		327 25	138 18	118 59

A brief description may now be given of the rolling-stock specially designed and constructed for the 2 ft 6 in gauge Barsi Light Railway in India

Thanks to the courtesy of Messrs Kitson & Co, Leeds, and of the Leeds Forge Co, the writer was able to inspect the Barsi Light

Railway stock exhibited at Newlay in October 1896, and the diagrams are here shown (Plate VII) by permission of the consulting engineer, Mr Everard R Calthrop, who has had valuable experience of Indian requirements, and whose name is well known in connection with the light railway question generally

In the year 1870, the Government of Bombay constructed a road—with earth works, cuttings, and bridges—from Barsi Road Station, on the Great Indian Peninsular Railway, to Barsi, a distance of 22 miles The bridges were supposed to be built of sufficient strength to carry

been

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of State a concession to construct a light railway on the road (to Barsi, and since beyond), and this stock has been designed and constructed for it

A rail weighing 35 lbs per yard has been adopted, and the maximum axle load fixed at 5 tons Mr Calthrop gives the following details of train loads —

	Tons	Cwt
Max weight of engine in working order,	29	8
Train load on gradient of 1 in 100	260	0
Actual tare weight of wagon,	4	2
Max load limit per wagon,	15	8
Max weight of goods hauled,	190	16, or 73% of train.
Min dead weight of train	69	4, or 27% of train
Composition of train,	12 wagons and 1 brake	

Mr Calthrop lays great stress on "the necessity of uniformity of axle loads for engines, carriages, and wagons on light railways of narrow gauge, when the prime object is the reduction of the weight and cost of the track to the lowest possible figure compatible with economy'

been desig

load of 5

per yard

miles per l

are as follows —

	Ft	In
Height at centre,	10	0 from rails
Height at sides,	9	0 " "
Width,	7	6

The locomotives (Plate VII fig 2) are tank engines of the "consolidation" type, having 8 coupled wheels, 2 ft 6 in in diameter, bearing 19¾ tons on a coupled wheel base of only 8 ft 3 in, and a trailing bogie All the wheels, coupled and trailing, are steam braked The total weight of the engine, fully loaded up, in working order, is

29 tons 8 cwt The valve gear is of the Walschert type The engine has an extended smoke box The following details may be quoted —

Capacity { Water,	800 gallons.
Capacity { Fuel,	80 c ft
Cylinders, diameter	13 inches
„ stroke,	18 inches
Heating surface, tubes	484 sq ft
„ „ Fire box	44 sq ft
„ „ Total,	528 sq ft
Fire grate area,	$8\frac{3}{4}$ sq ft
Tubes, 110,	$1\frac{3}{4}$ in diam outs

The haulage power of this locomotive was calculated on a basis of a train load, exclusive of engine, of 151 tons taken up a gradient of 1 in 57, at 1036 tons* on the level and straight and at 276 tons on the proposed ruling gradient of 1 in 100 on a curve of 600 ft radius As a matter of actual performance at Newlay the engine hauled 190 tons up the gradient of 1 in 57, so that the theoretical figures have been favourably under estimated

For purposes of comparison it may be mentioned that the Cooch Behar State Railway locomotives, on the same gauge, have a grate area of 5 18 sq ft, and cylinders $8\frac{1}{2}$ in diam. by 12 in stroke, carry 400 gallons of water and 20 c ft of fuel (about half a ton of coal, for example), have six wheels coupled on a base of 8 ft 6 in, and were required to haul only 275 tons on the level The axle loads on the coupled wheels amount to 13 tons 4 cwts 3 qrs on a wheel base of 8 ft 6 in, as compared with 19 tons 15 cwts on a wheel base of only 8 ft 3 in on the Barsi Light Railway The Cooch Behar State

[illegible] and lighter rails and bridges, the [illegible] per yard [illegible] power with a uniform axle load of 5 tons has been the leading motive in the design of the Barsi engines It is scarcely correct to say that this has saved the weight of the rail, for that does not depend only on the maximum axle load on any *one* pair of wheels, and it has been accomplished by the concen [illegible] base, which has made it

[illegible] been to combine the maximum carrying capacity with the minimum tare weight Of the

[illegible]

our locomotive superintendents in India now generally recognise—identity and interchangeability of parts and uniformity in dimen

* *Engineering*, October 30 1896

sions, wherever possible, are regarded as essential The following details are common to the three kinds of goods stock —

	Ft	In
Length over head stocks,	25	0
Width,	7	0
Length over buffers,	28	3
	16	8
	4	3
	20 tons	

All three sorts of wagons are of the bogie type, and built through out of Fox s pressed steel The makers claim that, although wagon £6 5s per ton, as against by about 15 per cent on onsist of fewer separate pieces, and they require fewer knees and less riveting, they suffer, therefore, less from vibration and corrosion, and accordingly last longer On the other hand, it appears to the writer that repairs and renewals of parts can be more easily effected on built-up frames Of the two types of bogies the non bolster type would seem to be quite good enough for 2 ft 6 in gauge stock, its weight is made up as follows —

	Cwt	Qrs	Lbs
Weight of bogie,	8	3	0
" " wheels and axles,	12	2	0
" " brake,	1	0	10
	22	1	10

The swing bolster type weighs, with brakework as above, 25 cwts 2 qrs 10 lbs The wheels have a diameter, on their tread, of 1 ft 11 in The high sided wagon has a capacity of 1000 c ft All are fitted with a hand brake which can be applied or taken off from either side of the vehicle, the brake is applied to one bogie only

The length of the composite passenger car (Plate VII fig 6) is 43 ft 3 in over buffers, and 40 ft over head stocks The distance between centres of bogies is 28 ft The bogies and under frames are of pressed steel The body of the car was made by the Lancaster Rail way Carriage and Wagon Company, is 40 ft 6 in long, and 7 ft 6 in wide over the sunshades, with a clear width of 6 ft 2 in inside, and is divided into luggage and brake compartment, an upper class compartment with sleeping berths and lavatory, and a lower class compartment with transverse seats The end platform and centre writer see carriages s required, such as and on the Con tinent Sunshades are absolutely necessary in a country like India. There is a brake on each bogie, one worked directly by the hand wheel in the compartment, the other indirectly, but with equal effect,

through a pull bar connection The over hang is such that, on the 2 ft 6 in gauge, we have here coaching stock 6 ft 8 in wide over pillars, as compared with a width of 8 ft 0 in on the standard 4 ft $8\frac{1}{2}$ in gauge, the height, too is ample, being 10 ft from rail level at the centre, and 9 ft at the sides A flexible buffer coupling has been adopted, permitting a radial movement through an angle of 36 degrees, so that the stock can be admitted to sidings on curves with the maximum radius of 150 feet

The line at the Newlay Exhibition of Barsi Light Railway stock in October 1896 was laid with 30 and 35 lb Vignoles rails on steel sleepers, supplied by the Moss Bay Hæmatite Steel and Iron Co, Workington A diagram of the trial train is shown in Plate VII fig 1 The wagons and cars took the 150 ft radius curves without difficulty, while the engine was able to manage curves of 250 ft radius nominally, but in places much sharper, measurements made by the writer indicating radii of 190 and 210 ft at two points chosen at random. An actual load of 190 tons* was taken up a gradient of 1 in 57 There is no doubt, therefore, that the engine can work the train load of 260 tons on the ruling gradient of the Barsi Light Railway as required, a load which would, on a passenger train, provide accommodation for 30 upper class and 736 lower class passengers, while, with 12 goods wagons and a brake van, its capacity would be equal to $190\frac{3}{4}$ tons of goods and 38 passengers Mr Calthrop mentions this in support of his contention that the 2 ft 6 in gauge "possesses the greatest carrying capacity per cent of capital cost"

In actual use in India, the usual train load is one lower-class carriage and one composite brake, with nine loaded goods wagons, making up a gross load of about 210 tons

	Rs	£
Engine	32 160	2010
Saloon car,	19,420	1214
Composite brake van,	17,480	1092
Lower class car,	15 380	961
Low sided wagon	2 040	127
High sided wagon,	2 680	168
Covered goods wagon,	2,640	165

* *Engineering* October 30, 1896

The cost of this 2 ft 6 in gauge locomotive, therefore, is greater than that of an ordinary F class metre gauge engine Its tractive power is about the same Its wheels are smaller, and it has a greater ratio of length of stroke to diameter of wheel, and is only suited therefore to run at a much lower speed It brings nearly as much adhesion weight on a shorter wheel base, 19¾ tons on 8 ft 3 in, and the axles being so close together a heavier load on each sleeper

The line is laid mainly on one side of the public road, and parallel to the canal, which it crosses three times

From the Wisbech home signal the track changes to a 50 lb flat footed steel rail (Plate VIII fig 1) resting on a flat cast iron chair or bearing plate, through which it is fastened to a transverse sleeper of creosoted pine, measuring 9 ft by 10 in by 5 in, by means of a compressed oak trenail and a wrought-iron dog spike The sleepers are spaced 3 ft apart, centre to centre, and packed in gravel ballast. To the Vignoles rail a light 24 lb wrought iron guard rail is fastened by $\frac{3}{4}$ inch wrought iron bolts passing through cast iron distance pieces—leaving a clearance of $1\frac{1}{2}$ inch—at intervals of 18 inches This arrangement was adopted as a substitute for the ordinary tram rail Like the latter, it would permit the track to be paved with granite setts—as was then intended—in the four foot as well as outside the rails, but it differed from the tram rail in that it could carry railway stock running entirely on the tread, and not on the flange of the wheel So much less objectionable, however, did the line look, when actually laid, than the road authorities had expected—so much more formidable are working drawings, especially sections, than the top view of the finished track—that the railway company was not called upon to incur the expense of paving except at level crossings, as where, for example, the tramway curves across a public road just as it emerges from Wisbech Station The road authorities were lenient, and not only the cost of paving or consolidating the road up to the same level as the rest, and so maintaining it, could be saved in such a case, but also the guard rail, distance pieces, and bolts, which are obviously superfluous The quantities and weights of materials are given in the statement on page 257.

In regard to points and crossings, it may be observed that the switch and stock rail are fastened by means of a bolt passing through them, a cotter, and a padlock, the key of the latter being in charge of the goods porter at the stopping place

As is usual on tramways, the trains on this line stop to pick up [illegible] e wayside, but at each of [illegible] oned sidings and a goods [illegible] of accommodating goods traffic A goods porter, assisted in one or two instances by a lad, is put in charge of the place, and the lock up—which may consist of one room, 17 ft by 11 ft in area—serves as an office and sack store as well At the Upwell terminus there is a water tank and pit for the engines This is practically all that is required in the way of stations There is neither platform, telegraph nor signalling to be provided.

A gang of one platelayer and three labourers maintains the line

The rolling stock consists of five locomotives and nine passenger cars, but for goods, and for passengers also in case of emergency, main line stock is available

WISBECH AND UPWELL RAILWAY

QUANTITY OF MATERIALS IN ONE MILE SINGLE LINE WITH WROUGHT IRON GUARD RAIL

DESCRIPTION	No	Tons	Cwts	Qrs	Lbs
Steel rails, 50 lbs per yd, in 30 ft lengths, 2 in on the head, 4 in on the flange, and 4 in deep,	352	78	11	1	20
Wrought iron guard rails, 24 lbs per yd, in 30 ft. lengths,	352	37	14	1	4
Cast iron chair plates, 11 lbs each, 2 to each sleeper	3600	17	13	2	8
Cast iron distance pieces, 3 lbs each, 18 in apart, . .	7040	9	8	2	8
Fish plates for rails, 15 lbs per pair,	351	2	7	0	1
Fish plates for guard rails, 5 lbs each, one only at each joint, .	176		15	2	24
Fish bolts and nuts, 0 63 lb each, ⅞ in diam, and 3½ in long,	1404		7	3	16
Fish bolts and nuts for guard rails, 0 51 lb each, ⅞ in diam and 2½ in long	1404		6	1	16
Wrought iron dog spikes 5½ in long ⅜ in square, 0 60 lb each, 2 to each sleeper,	3600		19	1	4
Trenails compressed oak, 5½ in long 1 in diam, 1½ in at shank, 2 to each sleeper,	3600				
Sleepers, ...	1800				
Wrought iron distance piece bolts ⅜ in diam, 4½ in long 18 in apart, 0 80 lb, . .	7040	2	14	0	6

The cost of a locomotive appears to be about £1400 Fig 2, Plate VIII, is a diagram of an engine with the casing removed There is a platform at either end, the driver standing upon the front one, and the reversing wheel and regulator being arranged to work from both ends of the engine The following details may be noted —

Cylinders, . .	11 in × 15 in.
Tractive power, . .	50 42
Heating surface of tubes, .	306 22 sq ft.
" " fire box, .	43 24 "

Total heating surface, . .	349 46 sq ft
Grate area, . .	9 70 ,,
Boiler barrel plates,	$\frac{5}{16}$ in thick.
Back plate, .	$\frac{1}{2}$,,
Throat plate,	$\frac{7}{16}$,,
Front tube plate,	$\frac{5}{8}$,,
Fuel capacity,	23 cub ft, or 1 ton of coal
Consumption of fuel	27 lbs (Welsh coal) per train mile, 21 lbs per engine mile

Under the Act certain regulations are enforced in regard to locomotives The engine must be free from noise, produced by blast or the clatter of machinery, such as the passengers or the public might reasonably complain of, and it must not emit smoke or steam to such an extent as they might fairly object to All fire used by the engine must be concealed from view, and the machinery must be covered at all points above 4 inches from the level of the rails, the engines are boxed in, therefore, with plates at the sides

The maximum speed permitted is 8 miles an hour, on facing points it must not exceed 4 miles an hour A governor, therefore, is fitted to each engine (or, as the permanent way inspector expressed it, the engine is "slotted") so that when the speed of the engine exceeds 10 miles an hour it shall cause the steam to be cut off and the brakes applied

The engine must be provided with a speed indicator, with a special bell, to be sounded as a warning as may be necessary, and with a suitable fender, in order to ward off obstacles The fender attached to each end of the engine is an uncompromising, straight-edged grid iron, commonly called a "cow killer," whereas the V shaped "cow-catcher"—used in India, America, and elsewhere—would throw a man or animal (which had broken through the fence and was caught on the line) off sideways, and would not necessarily kill him or it outright

Each coupled wheel must be fitted with a brake block, which may be applied by screw, by treadle, or by other means, and also by steam The Westinghouse and hand brakes are used The engine and cars must be capable of being brought to a stand still at certain places, and, in case of emergency, within a reasonable distance Accordingly, the Westinghouse brake is fitted to all cars, as well as engines

patterns
osite car
on third
omposite
ird class

passengers, and weighing, when empty, 10½ tons Both types have platforms and doors at each end, by which the passengers may enter and leave the compartments, and a central gangway through which the conductor may pass from end to end of the train, there being a

sliding door opening between the compartments, flaps let down over the couplings, and hand rails projecting from one platform to another

The maximum permissible loads are—for passenger trains, 9 vehicles (the two larger tramcars each to count as 2 vehicles), for mixed trains, 10 vehicles 4 of which may be loaded goods trucks, and for coal trains, 4 loaded trucks in winter and 5 in summer

The time table provides for a daily service of 6 passenger and 3 goods trains from Wisbech to Upwell, and of 7 passenger and 3 goods trains from Upwell to Wisbech No coal or dead buffer trucks are to be worked by these tramcar trains, a special trip has to be run for the working of such traffic

An ordinary passenger train may include an engine, three cars, and a brake van, more cars being required, perhaps, on Saturdays The train staff consists of a driver, a fireman, and a conductor, the last sells tickets

Two drivers and two firemen are employed on the line at one time, and the following locomotive staff is charged to the tram way —

3 drivers
3 firemen
2 cleaners
$\frac{1}{4}$ working foreman, shop fitters, etc, when an engine is under repairs

The following are the permanent traffic staff engaged on the tram way —

1 conductor
2 lad porters
1 acting guard

And assistance is rendered by the Wisbech Station staff as follows —

Porter and pointsman, cleaning cars
Lampman, lighting cars
Parcels porter, to deal with parcels on and off trains
Clerks, doing the necessary clerkage

The rates and fares are given in the accompanying statements

therefore, to £1_0

Of the gross receipts, £1013 was from passengers,

Wisbech and Upwell Tramway.

The Wisbech rates, including collection or delivery, cover the haulage over the Tramway, and no additional charge is made when charged at station to station rates.

The following charges are made on Merchandise from or to Wisbech:

Between Wisbech and	On traffic passing over the railway: Merchandise in Classes 1 to 5 of General Railway Classification Carted in Wisbech only		Merchandise in Classes A, B and C of General Railway Classification Station to Station		On traffic not passing over the railway: Packed Manure 5 to 8 Station to Station	Coal 6 tons.	Coke 4 to 8	Classes A and B of General Railway Classification 4 tons	Packed Manure 5 to loads	Potatoes 5 ton loads	Grain 5 ton loads	Oil Cake 5 to loads	Other Station to Station Merchandise 1 General Railway Classification Minimum 2 tons	Merchandise in Classes 1 to 5 of General Railway Classification Minimum 3d
	Per ton.	Minimum	Per ton.	Minimum	Per ton.	Per ton.	Per ton	Per ton	Per ton	Per ton	Per ton	Per ton	Per ton.	Per ton
Elm Bridge	3/4	2d	10d	2 tons		1d	3d	3d					5d	1/8
Boyce's Bridge	3/4		1/3			3d	5d	4d					5d	1/8
Outwell Basin	5/0	3d	1/8			4d	[illegible]	6d					10d	1/8
" Village	5/0		2/1			6d	10d	9d	10d	10d	10d	10d	1/3	1/8
Upwell	6/8		2/6		2/1	8d	1/1	1/0	10d	10d	10d	10d	1/5	1/8
Elm Bridge and	station to station													
Boyce's Bridge	3/4	2d	10d	2 tons										
Outwell Basin	3/4		10d											
" Village	3/4		1/8											
Upwell	[illegible]0	3d	/6											
Boyce's Bridge & Outwell Basin	3/4	2d	10d	2 tons										
" Village	3/4		1/8											
Upwell	[illegible]0	3d	2/6											
Outwell Basin & Outwell Village	3/4	2d	10d	2 tons										
Upwell	3/4		1/8											
Outwell Village and Upwell	3/4	2d	10d	2 tons										

Goods Manager's Office (G. E. Ry.), Liverpool Street Station, 8/2/97.

WISBECH AND UPWELL TRAMWAY.

Fares

Miles.		Wisbech 1st Class	Wisbech 3rd Class	Elm Bridge 1st Class	Elm Bridge 3rd Class	Boyce's Bridge 1st Class	Boyce's Bridge 3rd Class	Outwell Basin 1st Class	Outwell Basin 3rd Class	Outwell Village 1st Class	Outwell Village 3rd Class	
1½	Elm Bridge, . . .	2d.	1d									
3¼	Boyce's Bridge, . .	3d	2d	2d	1d							
4¾	Outwell Basin, .	3d	2d	3d	2d	2d	1d					
5	Outwell Village, .	4d	3d	3d	2d	3d	2d	2d	1d			
5¾	Upwell, . . .	4d.	3d	4d	3d	3d	2d	2d	1d	2d	1d	Upwell

parcels and mails, £1565 from animals, goods, and minerals; and £11 from other sources

The working expenditure was thus distributed —

Maintenance of way and works,	£355
Locomotive power,	866
Repairs and renewals of engines,	308
Repairs and renewals of cars,	13
Traffic expenses,	580
Rates, taxes and tolls,	69
Goods claims,	21
	£2212

No charge, of course, was made for direction, management, and supervision, nor, it may be added, was any required on account of compensation for personal injury, although the line runs across, and on the side of, the public roads

The car mileage amounted to 32,896, and the number of passengers conveyed was 103,639 The total inward goods traffic was 19,504 tons, and outward goods 16,921 tons

The gross traffic receipts during five years have been £2338 in 1892, £2541 in 1893, £2570 in 1894, £2395 in 1895, and £2621 in 1896

Traffic is busiest in the winter, when at Upwell as many as 13 or 14 trucks perhaps, are loaded up daily, the general average being about 10 Lynn sends oil cake, maize, and barley. From the neighbourhood, by means of the intermediate sidings, are brought apples, potatoes, carrots, etc As a rule, mangolds cannot bear the freight charges If the farmer's men are not busy, he will often cart them to Stonea, six or seven miles off, instead of the two or three miles to Upwell, and may thus save as much as 2s a ton in railway carriage When the demand for new potatoes in the London market has relaxed, and the imports from Jersey and the Continent crowd out home produce, the farmers store their potatoes till the winter, when most of this traffic is carried

The summer fruit traffic has encouraged the farmers, year by year, to put more of their land under such cultivation

On the whole, the results are considered to be satisfactory both to the company and to the district served by the tramway Net receipts of £420 on a capital expenditure of £41,926—or little more than 1 per cent —may not bulk largely in the returns published each year, but we must remember that these figures correspond with the haulage on the light section only, and that there is a much greater, if unrecorded, profit to the company due to the additional traffic, more especially in apples, potatoes, and other agricultural produce, created and fostered by the tramway, and carried over the main line to

London at an additional working expenditure which is scarcely appreciable English railways earn their dividends hardly, and cannot afford to be too philanthropical, but, given facilities for throwing out economical feelers and feeders, they are ready enough to add an honest penny to their revenue, and to benefit the country districts

We are here in the very centre of the eastern or arable section of England The wheat area has been shrinking eastward for the last twenty years, but there have recently been increases in barley, oats, and potatoes, principally in the eastern counties, which may partly compensate for the decrease of wheat cultivation. This corner of England comes next to Lincolnshire, Lancaster, and perhaps, Chester, as a source of supply of potatoes The produce of mangolds, wheat, and barley, too, is fairly large, and it is satisfactory to know that, in the neighbourhood of the Wisbech and Upwell Tramway, more land is every year being devoted to the cultivation of fruit and potatoes

The surface of this Fen country is, of course, flat Very little bridging had to be provided The road was broad enough to take the tramway on one side, only for a short distance was it considered necessary to cut a corner and take up land for the purpose No fencing or partition from the public road was required Competition for traffic on the part of road or canal has not been formidable, and, altogether, the circumstances have been favourable and the results satisfactory A saving in capital cost would have been made had it been practicable to dispense with the guard rail at once, and to use old but serviceable rails set free from the main line

It would appear that the railway companies may very well take advantage of the Light Railways Act, 1896, in two obvious ways— [illegible] ches with old rails and fish [illegible] by *disclas ing* certain exist-

The Three Horse Shoes and Benwick Line, G E R —A light goods [illegible] from Three Horse Shoes (a goods depôt [illegible] Penwick, in the Isle of Ely, Cam [illegible] the Great Eastern Railway under their General Powers Act of [illegible] [58 & 59 Vict session 1895] It is to be a single track, 4 miles 3 fur 2 70 chains long, with a wharf or quay on the north west bank of the river Nene The railway is not to carry passengers, but main line goods stock, including engines, may circulate freely on it

The branch takes off, by a back shunt, from the Three Horse-Shoes goods station on the main line, and runs over the flat low lying fen land, through Quaker's Drove, West Fen Drove Burnt House Drove depot at 2 miles 29 chains, Jones' Drove, and White Fen Drove—farmers' depots, with sidings and lock ups on the same pattern as on the Wisbech and Upwell Tramway—to Benwick

The line is so directed across the fields as to interfere with the drains and dykes as little as possible

The track consists of old second hand 80 lb bull headed steel rails,

released from the main line, fished with second hand fish plates weighing 43 lbs a pair and new fish bolts and nuts, and supported in new cast iron 43 lb chairs, which are held with new keys, and fastened with new spikes and trenails to new creosoted sleepers The estimate allows for 12 in of ballast under the sleeper, and as the soft soil, yielding to the effect of the fen drainage, must absorb a good deal of the ballast, an inferior quality is first put in to get a bottom, and the best is reserved for filling and packing

The probable cost per mile of such track may be estimated at about £972, as shown in the accompanying table The figures may be compared with the alternative estimate of about £868 per mile for a light line laid with new 56 lb F F steel rails, spiked directly to the sleeper New chairs had to be provided, because the old standard chair was too high lipped for worn rail heads, and in such lines as we are considering, we may safely assume that it will be most economical in the long run to use new sleepers and new fastenings, and only to take rails fish plates, and chairs second hand, if they are available from the main line The rate quoted for old rails and fish plates is, of course, not one that can be fixed with great accuracy, at the best, it can only represent a book value

The country traversed is flat and low, the level drops, perhaps, as much as an inch per annum in consequence of drainage operations, … troughs which conduct … to allow for sinkage in … a considerable depth to carry the line over the larger engine drains As an alternative to steam power, wind mills are erected to work the pumps on these engine-drains, and the sight of them is a pleasant relief to the general monotony of the landscape

The construction of the timber troughs—of which there are about twenty five—is at once simple and economical (fig 1, Plate IX) Including the clearing out of the dyke, one of the most expensive items, the cost of each is probably not more than £6 or £7 The effective section is 18 in square, each side being built up with two planks 9 in wide and 3 in thick, laid longitudinally on edge, one over the other, the floor and cover of the trough consisting also of 3 in planks

The type of timber bridge adopted to carry the railway over the engine drains—which have to be crossed in four or five instances, although the intersection of water courses is avoided as far as possible—consists (fig 2, Plate IX) of a 12 or 15 ft span on piles driven to a depth of about 24 ft

Over the river Nene is to be built a bridge (fig 3, Plate IX) consisting of four small spans, and a central one of 25 ft 6 in, for which old wrought-iron girders are available The pile foundations will reach to a depth of 34 ft The minimum headway, about 9 ft clear, is sufficient for barges to pass under the girders

The fencing is an expensive item, grudgingly provided by the thrifty engineer It is of the usual wooden post and rail pattern,

APPROXIMATE COST OF ONE MILE OF PERMANENT WAY, WITH SECOND HAND 80 LB RAILS AND FISH PLATES FROM MAIN LINE

Tons	Cwt	Qrs.	Lbs	No	Description	Rate £	Rate s.	Rate d	£	s	d
114	0	0	0	Approx	Bull headed rails, old second hand 80 lbs to the yard originally,	2	5	0	256	10	0
6	15	0	16		Fish plates second hand 43 lbs a pair,	2	5	0	15	4	9
0	17	1	4	1408	Fish bolts and nuts, } new	9	7	2	8	1	10
74	6	2	8	3872	Chairs 43 lb, } new	3	0	0	222	19	8½
				3872	Keys, } per1000 } new	4	0	0	15	9	9
				7744	Trenails, } per1000 } new	2	2	6	16	9	1
4	15	0	8	7744	Spikes, } new	7	8	10	35	7	6
				1936	Creosoted sleepers, } new	0	3	1	298	9	4
				1760	Yards run, labour in laying,	0	1	0	88	0	0
					Use of loco for distributing say				15	0	0
									£971	12	0

APPROXIMATE COST OF ONE MILE OF PERMANENT WAY, WITH NEW 56 LB VIGNOLES RAILS AND OTHER MATERIAL.

Tons	Cwt	Qrs	Lbs	No	Description	Rate. £	Rate. s	Rate. d	£	s.	d
88	0	0	0		Steel rails flat footed, 56 lbs to the yard,	4	15	0	418	0	0
5	0	0	0		Fish plates,	5	10	0	27	10	0
0	14	0	0		Fish bolts,	9	10	0	6	13	0
2	10	0	0		Dog-spikes,	8	0	0	20	0	0
				1936	Creosoted sleepers,	0	3	1	298	9	4
				1760	Yards run, labour in laying,	0	1	0	88	0	0
					Use of loco. for distributing, say,				15	0	0
									£867	12	

and may cost 1s 5½d or 1s 6d a yard As a ditch will be dug and a raised thick set hedge planted within the fence—making up the ultimate cost to about 2s a yard—the latter will not require renewal as it wears out

Sufficient land has been taken up by agreement with the farmers, at an all round price of £30 per acre, to allow for doubling the track, if necessary, hereafter, while, at the "droves' or depots, the width from fence to fence will leave ample room for a 30 ft roadway beyond the sidings

The plan of these sidings is that of a loop with two dead ends (fig 4, Plate IX), and carts approach by the usual unmetalled fen road,

A rough estimate of the cost of way and works for a light railway

coal, from *via* Peterborough

the main line with which the Benwick branch connects, as many as 40 specials sometimes *running in a day* Of local agricultural produce, carrots, potatoes, and other roots form the bulk of the traffic The farmers to be served by the new branch own or rent large holdings and are well to do, so that there is every prospect of the Benwick line paying

The Easingwold Railway—The Easingwold Railway is owned

ordinary

, on the

chains

(*a*) Parliamentary and legal expenses,	£1,267	3	7
(*b*) Way and works,	11,973	3	10
(*c*) *Locomotive*,	1,119	0	0
(*d*) Coaches,	301	9	7
(*e*) Land, .	2,300	8	8
	£16,961	5	8

This railway is not—like the *Wisbech and Upwell Tramway*—laid

ht

m

it

footed steel rail resting directly on the sleeper To the guard sleepers—those nearest the rail joint—and to the middle two the rail is fastened by an inside and outside fang bolt and clip, the bolt passing through the flange of the rail, to the other sleepers the rail is held down by two dog spikes on the outside and one on the inside The

ROUGH ESTIMATES OF COST OF ONE MILE OF LIGHT GOODS RAILWAY IN THE FEN DISTRICT

Quantities, Descriptions, and Rates of Items				With Old 80 Lbs Bull headed Rails	With New 60 Lbs Flat Footed Rails
Yards.		Description	Rate	£ s d	£ s d
3520	Run.	Fencing with quickset and ditch complete, ...	2/	352 0 0	352 0 0
	Acre	Land, six acres to the mile, ...	£30	180 0 0	180 0 0
	Mile	Permanent Way, as shown in detail above, ...	(11/ or 10/ approx.)	968 0 0	880 0 0
4860	Cube	Ballast, ...	2/	486 0 0	486 0 0
	No	6 Timber trough culverts, 1 ft. 6 in. × 1 ft. 6 in., . .	£7	42 0 0	42 0 0
	No	1 Timber bridge, over engine drain, on piles, . . .	£30	30 0 0	30 0 0
	No	1 Goods Depôt, including sidings (proportion) . . .	for	1000 0 0	800 0 0
				£3058 0 0	£2770 0 0

and may cost 1s $5\frac{1}{2}$d or 1s 6d a yard As a ditch will be dug and a raised thick set hedge planted within the fence—making up the ultimate cost to about 2s a yard—the latter will not require renewal as it wears out

Sufficient land has been taken up by agreement with the farmer, at an all round price of £30 per acre, to allow for doubling the track, if necessary, hereafter, while, at the "droves" or depots the width from fence to fence will leave ample room for a 30 ft roadway beyond the sidings

the Benwick branch connects, as many as 40 specials sometimes running in a day Of local agricultural produce, carrots, potatoes and other roots form the bulk of the traffic The farmers to be served by the new branch own or rent large holdings and are well to-do, so that there is every prospect of the Benwick line paying

The Easingwold Railway—The Easingwold Railway is owned and worked by a private company It was constructed as an ordinary railway under a special Act of 1887 and runs out from Alne on the North Eastern Railway, to Easingwold, a distance of 2 miles 37 chains The line was opened in July 1891

The cost was as follows —

(*a*) Parliamentary and legal expenses,	£1,267	3	7
(*b*) Way and works	11 973	3	10
(*c*) Locomotive	1,119	0	0
(*d*) Coaches,	301	9	7
(*e*) Land,	2,300	8	8
	£16 961	5	8

This railway is not—like the Wisbech and Upwell Tramway—laid on a public road but—like the Three Horse Shoes and Benwick light goods line—right through the fields

After clearing the points at Alne, the permanent way changes from the bull headed rail in chairs of the main line to a 21 ft 60 lb flat footed steel rail resting directly on the sleeper To the guard sleepers—those nearest the rail joint—and to the middle two the rail is fastened by an inside and outside fang bolt and clip the bolt passing through the flange of the rail, to the other sleepers the rail is held down by two dog spikes on the outside and one on the inside The

ROUGH ESTIMATES OF COST OF ONE MILE OF LIGHT GOODS RAILWAY IN THE FEN DISTRICT

Quantities, Descriptions, and Rates of Items				With Old 80 lbs. Bull-headed Rails	With New 76 lbs. Flat-footed Rails
Yards.		Description	Rate	£ s d	£ s d
3520	Run	Fencing with quickset and ditch complete, . . .	2/	352 0 0	352 0 0
	Acre	Land six acres to the mile	£30	180 0 0	180 0 0
	Mile	Permanent Way, as shown in detail above, . . .	(11/ or 10/ approx.)	968 0 0	880 0 0
4860	Cube	Ballast, ...	2/	486 0 0	486 0 0
	No	6 Timber trough culverts, 1 ft 6 in × 1 ft 6 in . .	£7	42 0 0	42 0 0
	No	1 Timber bridge over engine drain on piles, . . .	£30	30 0 0	30 0 0
	No	1 Goods Depot, including sidings (proportion) . . .	for	1000 0 0	800 0 0
				£3058 0 0	£2770 0 0

sleepers—of the usual dimensions, 9 ft by 10 in by 5 in —are of uncreosoted larch, the intervals between them being 32 ins, centre to centre, they are packed in stone ballast The line is maintained by only two platelayers

The railway is practically a surface line The steepest gradient is 1 in 100 There is no other bridging than a 10 ft girder spanning a small stream between Alne and Crankley The line of fencing has been planted with thick-set, but that does not seem to thrive

[illegible] Crankley—each [illegible] a gatekeeper, [illegible] cted with the running line by a crossover, not a turnout

At the present terminus, Easingwold, are a passenger station building and platform, a goods shed of corrugated iron and a platform, an engine shed of corrugated iron, with an engine pit, bench and vice, forge, sand oven, cupboard for oil and waste, etc, a coal stage a load gauge, a weighing machine, a water column, and a depôt belonging to the 'Farmers' Trading Company,' with a raised platform, a siding running up to it, and coal shoots on the off side

The small passenger station building contains an office room for the secretary, another for the station agent, a waiting room, and a lamp-room

The Easingwold Station points are locked and controlled by an Annett's key, kept and used by the guard or driver, and applicable also to the siding points at ' Ben Smith's and Crankley level crossings. As is well known, the possession of such a key places the control of all these points in the hands of its holder, and it cannot be removed from the lever until the line has been re-made for through running

The rolling stock consists of one locomotive engine and two passenger coaches

The locomotive, a small six wheels-coupled tank-engine, with a 12 in by 18 in cylinder, weighs not more than 20 tons 3 or 4 cwts when fully loaded with coal and water but takes a load of two passenger coaches and eight or ten loaded goods wagons It carries 10 cwts of coal and 450 gallons of water, ample for the short runs to and fro, and, the grades being easy, it is provided with a hand brake only

One of the passenger carriages has a compartment occupied by the guard, who controls a hand brake and has charge of the luggage

Goods stock belonging to the main line is taken over and used on the branch, subject to demurrage charges after two days' detention

The train service—much more liberal than probably a trunk line, working such a branch, would care to provide—consists of no less than nine trains each way That this should be possible is a remarkable example of economical working on a very small scale, and with a separate, small, but sufficient staff, i e, under independent and, therefore very difficult conditions Such results could only be obtained by the readiness of every servant of so small a staff to do

anything that is required of him. Their duties must be largely interchangeable.

Thus, the running staff consists of two men, who act as guard and driver alternately, and of a fireman. And at certain times one driver relieves the fireman, in which case—as mentioned below—one of the station porters acts as guard.

The station staff consists of an agent, two clerks and two porters at Easingwold. One of the latter does 'guard' for the last two trains. Such versatility of service is the very essence of economical light railway working.

It is just as evident in the administrative staff, which consists of the secretary, Dr Fuller Hicks, whose valuable services are purely honorary, and of his paid assistant-secretary, Mr Bensley, who is also the secretary of the "Farmers' Trading Company" above referred to. Thus, the costs of superintendence and administration—so likely to bulk largely in the expenditure of a separate organisation on such a small scale—are reduced to a minimum.

The rates are fixed in agreement with the North Eastern Railway Company, who determine the through rates, and allow the Easingwold Railway Company a proportion.

There are two Parliamentary trains daily, the first and last each way. The passenger fares are 3d., 4d., and 6d., third, second, and first-class respectively, and the return charges are double.

A progressive revenue account may be thus abstracted:—

Half Years	Receipts	Expenditure	Balance
	£ s d	£ s d	£ s d
Dec 1891	635 4 1	488 12 5	146 11 8
June 1892	662 15 10	579 17 3	82 18 7
Dec ,,	647 16 2	675 15 0	27 18 10*
June 1893	656 6 4	528 16 3	127 10 1
Dec ,,	753 3 1	563 16 10½	189 6 2½
June 1894	692 10 7	480 3 9	212 6 10
Dec ,,	866 4 3	515 14 2½	350 10 0½
June 1895	722 8 4	445 13 3	276 15 1
Dec. ,,	829 15 1	515 5 1	314 10 0
June 1896	743 11 11	467 16 1	275 15 10
Dec ,,	892 5 3	501 12 1	390 13 2

* Deficit.

London Inwards the traffic consists mainly of grain, manure, lime, coal, etc All the coal and lime are received from Yorkshire and Durham collieries and kilns, and amounted to 4170 tons in 1896. The total tonnage of goods in that year was 14,546

Very roughly, 40 per cent of the gross receipts was contributed by passengers

r very direct—benefits which
to the railway are an earlier

At Alne, their junction with the North Eastern Railway, the Easingwold Railway Company do their own shunting, but the main line staff perform booking, clerking, and other station services for them at a small annual charge Engine and carriage repairs are carried out in the North Eastern Railway workshops In the division of earnings in station facilities, and other matters, the main line is liberal to the branch For example, on such occasions as agricultural show and other special days, the North Eastern Company help freely, without reference to the actual working agreement

Applications under the Light Railways Act —Of light railway proposals since the passing of the Act of 1896 there is now something to be said

When the Light Railway Commissioners sent up their first order, the Board of Trade decided—with reference to section 8 (2) of the Act—"to publish a short notice of the making of the order by the Commissioners, and of its submission for confirmation, in the form of an advertisement once in each of two successive weeks in the local newspaper which had contained the original notice of the application, accompanied by an intimation that any objections must be lodged with the Board of Trade within three weeks from the publication of the first advertisement"* Objections having been duly received by the department, the Board appoint a day for the consideration of the order, and give all objectors an opportunity of being heard The Board then consider the order with special reference to the points mentioned in section 9 of the Act, viz.—(a) the expediency of requiring the proposals—on account of the magnitude of the undertaking or its effect on an existing railway company—to be submitted to Parliament, (b) the safety of the public, and (c) any objections that

rd of
rail-
that

department first of all to tear themselves free from the old traditions, and afterwards to avoid drifting back into the old ways, it can only be by their steady determination to include no provisions in the name of safety which are unreasonable or inexpedient. If the Board, after making such amendments as they consider requisite, confirm the order, notice is given in the *London Gazette* of the confirmation, and

* *Report of the Proceedings of the Board of Trade under the Light Railways Act*, 1896, during the period ending 31st December 1897, etc.

the promoters are required to supply the public with copies of the order at a price not exceeding 1s a copy

The Light Railways Act came into operation on the 14th August 1896 The Board of Trade *immediately issued to local authorities a*

[illegible]

local inquiry at Basingstoke on the 28th January 1897 when Sir [illegible] the London and South Western [illegible] s company s proposal to connect [illegible] 'hawton on their Farnham Alton, [illegible] light railway

Of these twenty eight schemes † the following were withdrawn —

Length	Gauge	Engineer s Estimate	
M	Ft. In	£	
9	3 6	50 171	Cheltenham and District (Cheltenham to Winchcombe)
12½	3 6	63 6?5	Norwich and District
9¼	*4 8½*		*Gifford and Carvald*

The following were rejected —

Length	Gauge	Engineer s Estimate	
M	Ft In	£	
8¼	4 8½	52 784	Darenth Valley (Dartford to Eynesford)
22	do	89 469	Dartford District (Dartford to Eynesford Wilmington to Swanley, Farningham to Stansted)
26	3 0	36 938	[illegible]
4½	3 6	28 418	[illegible]
17¼	4 8½	108 571	[illegible]
6½	do	[illegible]	[illegible]

One was deferred —

Length	Gauge	Engineer s Estimate	
M	Ft. In	£	
14	4 8½	41 343	Llanfair and Meifod (Llanfair to Ardlleen)

* Appendix IX

† *Report of Proceedings of Board of Trade and of Light Railway Commissioners under Light Railways Act* (dated December 1897).

The following 18 were approved.—

Length	Gauge	Engineer's Estimate	
M	Ft In	£	
9¾	3 6	49,231	Crewe
2	4 8½	19,613	East and West Yorkshire Union (Robin Hood [illegible]
11	2 6	30,565	[illegible]
8¼	4 8½	41 978	[illegible]
11½	do	49,045	[illegible] and to
11½	3 6	67,596	Nettlested) [illegible]
13	4 8½	66 715	[illegible]
14	4 0	83 966	[illegible]
2¾	3 6	17,564	[illegible]
7	4 8½	24,991	[illegible]
12½	do	59,040	[illegible]
5¼	do		Quarries)
18½	do	76,030	Cromarty and Dingwall [illegible]
14½	do	53,511	[illegible]
13	do	60,000	[illegible]
10½	do	48 309	[illegible]
7¾	do	31,962	[illegible]
7½	do	26,756	[illegible]

Of those approved by the Commissioners the following were submitted to the Board of Trade for confirmation:—

Basingstoke and Alton
East and West Yorkshire Union
Potteries
Hadlow
Wrington Vale
Gower
Crewe
Flamborough and Bridlington
West Hartlepool.

And the first four of these were confirmed by the Board of Trade in December 1897.

Treasury assistance was sought by none under section 4 of the Act (in addition to advances made by any county, borough, or district council), but by the following under section 5 —

Elsenham, Thaxted, and Barnfield
Llanfair and Meifod.
Cromarty and Dingwall
Forsinard, Melvich, and Portskerra
The Mound, Embo, and Dornoch

Assistance from local authorities was sought by the following —

Elsenham, Thaxted, and Barnfield
Flamborough and Bridlington
Cromarty and Dingwall
Forsinard, Melvich, and Portskerra
Lauder.
The Mound, Embo, and Dornoch

Objections on the part of town corporations, district councils, or other local authorities affected, insufficient public need to justify the compulsory acquisition of land in the face of strong opposition, undue [illegible] are [illegible] the [illegible] oard [illegible] be rejected.

Omitting the Gifford and the Garvald (9½ *miles*), *and the Carmylie* (5¼ miles)—for which the estimated cost is not given—the [illegible] various gauges is approxi- [illegible] *s amount to £1,315,251,* [illegible] about £4560

In May 1897 also twenty eight applications were made for orders authorising light railways—19 in England, 4 in Wales, and 5 in Scotland. Of these the following were withdrawn —

Length	Gauge	Engineer's Estimate	
M	Ft In	£	
3	4 8½	6,019	Corporation of London Foreign Cattle Market Deptford
4	3 6	23,329	Torquay and Paignton.
10¾	4 8½	56,160	Dunfermline and Kincardine

The following were deferred —

Length	Gauge	Engineer's Estimate	
M	Ft I	£	
10	4 8½	45 500	Kelvedon Tiptree and Tollesbury (Kelvedon to Blackwater River)
6	3 6	38	Norwich and district (No 2
5¾	4 8½	3 3 [illegible]	Rea Valley (Minsterley to Churbury)
8¼	3 6	65 083	Llandudno and Colwyn Bay (Colwyn Bay to Degan roy

The following were rejected —

Length	Gauge	Engineer's Estimate	
M	Ft I	£	
3½	4 8½	1 980	Lastingham and Sinnington
2	3 6	11 8	Taunton (wholly within the borough)
10½	2 6	1 950	Llanfyllin and Llangynog

And 18 are shown as approved or passed by the Commissioners —

Length	Gauge	Engineer's Estimate	
M	Ft I	£	
9½	4 8½	44 413	[illegible]
24	do	106 250	[illegible]
12	4 0	43 594	[illegible]
8¾	3 6	51 563	[illegible]
14	4 8½	9 609	[illegible]
17¼	do & 3 6	108 481	[illegible]
9	4 8½	34 751	[illegible] Portla u)
11¼	do	68 587	Lizard (Helston to the Lizard)
12½	do	30 343	North Holderness (Beverley to Beeford)
20¼	do	116 40	Great Western Railway Company (Pewsey and Salisbury)
1½	do	16 741	St George and Hanham (Summerhill Road Bristol to Hanham)
5¼	do	69 255	West Manchester (approved in part)
15	do	45 9 4	[illegible]
9¼	2 6	21 309	[illegible]
4½	4 8½	56 160	[illegible]
13	do	88 700	[illegible]
3¼	do	131 691	[illegible] s on
18¾	do	110 000	West Highland Railway—Loch Fyne (Arrochar to Loch Fyne opposite Inveraray)

Treasury assistance under section 4, and assistance from local authorities, were sought by the following —

Bridlington, Beeford, and North Frodingham
North Holderness
Rea Valley
Llanfyllin and Llangynog
Tanat Valley
Welshpool and Llanfair

And of these the following —

Rea Valley,
Llanfyllin and Llangynog,

sought Treasury assistance under section 5 as well

The following —

Kelvedon, Tiptree, and Tollesbury,
Leek, Caldon, Low, and Hartington,[1]
Fraserburgh and St Combs,

sought Treasury assistance under section 5, and of these one —

Leek, Caldon, Low and Hartington,

sought assistance from local authorities as well

Omitting—for reasons presently to be given—the Corporation of London Foreign Cattle Market Deptford (3 furlongs in length), the Taunton (2 miles), and the Echt Extension (3¼ miles), the total length of 25 light railways is approximately 268 miles, and the engineers' estimates amount to £1,432,192, so that the average estimated cost per mile is about £5344

The Commissioners did not consider that the Deptford scheme (being entirely within the Metropolitan area) and the Taunton proposal (for a purely urban tramway) came within the scope of the Light Railways Act The Echt Extension—completing the Echt Light Railway by connecting it with the main line at Kittybrewster in the northern suburb of Aberdeen—lies almost entirely in tunnel or deep cutting and is, therefore, so costly and exceptional that it is [illegible]

[illegible] "animal, electric, or other mechanical," "animal or electric," etc , [illegible]

make an independent way within the town of Derby to reach the Great Northern Railway station.

The light railway from Helston to the Lizard will serve a large fishing industry, encourage tourist traffic, and bring the Cornish farmers' early vegetables and fruit to the great markets, tapping, as it will, an agricultural district capable of considerable development.

The proposal of the Great Western Railway Company, strongly supported by local opinion, to construct a light railway from Salisbury through the Avon Valley to Pewsey—and therefore passing over land acquired for military purposes—has been approved and the Board of Trade have since confirmed an Order, although the scheme was at one time strongly opposed by the War Office.

Crowland, by means of the Lincolnshire and Northamptonshire scheme, will now have direct railway communication with Postland on the Spalding and March line, G E R, and Peakirk on the Peterborough and Spalding Loop G N R.

Since the issue of the *Report of the Proceedings of the Board of Trade, under the Light Railways Act, 1896, during the period ending 31st December 1897 and of the Proceedings of the Light Railway Commissioners during the period ending 22nd November* 1897, applications for the following light railways have been approved by the Commissioners —

	Miles
Abergavenny and Monmouth	12
Grimsby and Saltfleetby	17½
Isle of Axholme	22
Kinver	4
Amesbury and Military Camp	10¾
Middleton (Lancashire)	8¼
North Shields Tynemouth and District	2
North Sunderland	1½
Rochester Chatham and District	14½
Isle of Sheppey	7¼
Ventnor	½
Bankfoot	3
	3
	1¼
	¼
	7¼
	6
	7
	17¼
	13¼
	2¼
	1
Dundee and Broughty Ferry	5¼
Maidens and Dunure (Ayr)	19½
Liverpool and Prescot	3
Central Essex (partly)	19½
Bardfield and Sible Hedingham	7¾
Merthyr Tydvil	3¼
Kelvedon Tiptree and Tollesbury	9¾
Kelvedon Coggleshall and Halsted (partly)	2

The total length of these 30 light railways is about 233 miles.

APPENDICES.

APPENDIX I

COST OF RAILWAY CONSTRUCTION IN DIFFERENT COUNTRIES

(FROM THE BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS, VOL X No 7, JULY 1896)

Numbers 1	COUNTRIES 2	Date to which Statistics apply 3	Mileage at that Date 4	Construction Capital Total 5	Construction Capital Per Mile 6
	I —EUROPE			£	£
1	Germany	31 3 1895	27,433	559 013 150	20 411
[illegible]	[illegible]	31 12 1891	17 077	329 771 950	19 310
[illegible]	[illegible]	[illegible]	20 901	985,387,350	47,138
[illegible]	[illegible]	[illegible]	22 490	617 517,550	27,446
5	[illegible]	[illegible]	18 441	326 564 650	17,708
6	Italy,	31 12 1890	6 493	154,221,650	23,752
7	Belgium (State Railways)	31 12 1893	2 038	55 368 800	27,168
8	Switzerland,	31 12 1893	2 079	44,612 500	21,473
9	Spain,	31 12 1889	6 273	113 624 550	18,113
10	Netherlands	1887	1,630	27,734,600	17,015
11	Denmark (State Railways)	31 3 1892	947	9 543,000	10 077
12	Norway,	30 6 1894	1,001	7,593 000	7,584
13	Sweden (State Railways),	31 12 1894	1,900	16,051 650	8 448
14	Roumania (State Railways),	31 12 1893	1 525	24,259,250	15,907
15	Servia,	1894	335	3 963,100	11,830
	Total,		130 575	3,275 286 750	25,083
	II — [illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,840
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11,830
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9,567
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 240
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12 283*
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 2[illegible]5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11 564
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,101
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9,018
9	Cape [illegible]	30 6 1895	2 531	36 611 3[illegible]0	14 465
10	New South Wales	30 6 1895	1 722	12 529 400	7 3[illegible]6
11	South Australia,	30 6 1895	3 119	37 922 200	12 158
12	Victoria,	30 6 1895	2,378	16 5[illegible] 300	6,52[illegible]
13	Queensland,	30 6 1895	550	2,0[illegible] 350	3 [illegible]04
14	West Australia	31 12 1894	419	3 518 600	8 397
15	Tasmania	31 3 1895	1,993	15 352,600	7,101
16	New Zealand,				
	T[illegible]		[illegible]	[illegible]	[illegible]354
	Total for all Europe [illegible]		[illegible]	[illegible]	[illegible]
	For the rest of the [illegible]		[illegible]	[illegible]	[illegible]
	Total for all the [illegible]		[illegible]	[illegible]	[illegible]

* Apparently ten rupees have been assumed to be equal to £1. Taking the rupee at about 16d, the cost would be £ 1[illegible]

APPENDIX II See Folding Table opposite.

APPENDIX III.

GROSS EARNINGS, EXPENSES AND NET EARNINGS PER MILE PER WEEK, PAYING INTEREST ON A LINE COSTING 10 000 UNITS PER MILE

Per Annum		Working Expenses taking, of Gross Earnings,—	Per Mile per Week in Units		
Interest on Capital	Net Earnings in Units		Gross Earnings.	Expenses	Net Earnings.
4 per cent,	400	40 per cent	12 8	5 1	7 7
		45 "	14 0	6 3	
		50 "	15 4	7 7	
		55 "	17 1	9 4	
4½ per cent,	450	40 "	14 5	5 8	8 7
		45 "	15 8	7 1	
		50 "	17 4	8 7	
		55 "	19 3	10 6	
5 per cent,	500	40 "	16 0	6 4	9 6
		45 "	17 5	7 9	
		50 "	19 2	9 6	
		55 "	21 3	11 7	
5½ per cent,	550	40	17 7	7 1	10 6
		45 "	19 3	8 7	
		50	21 2	10 6	
		55 "	23 6	13 0	

APPENDIX IV See Folding Table opposite

Net earnings

N. B.—The brackets

APPENDIX V

HALF YEARLY STATISTICS OF INDIAN RAILWAYS 1894

HEADINGS		East Indian	Indian Midland.	Grand Indian Peninsula	Bengal and North Western	Rajputana Malwa	Bhavnagar Gondal Junagarh Porbandar
Gauge of Railway,		5 6	5 6	5 6	3 3⅜	3 3⅜	3 3⅜
Mean mileage worked,	Miles	1844 67 1871 98	753 78 753 78	1490 08 1490 23	756 30 756 30	1674 02 1746 22	380 08 380 21
Inclination of steepest gradient		1/40	1/80	1/37	1/100	1/40	1/67
Length of steepest gradient,	Miles	3 98	2 40	5 85	3 42	3 40	0 07
Percentage of net earnings on capital outlay		5 19 4 36	1 41 1 11	4 72 1 29	3 78 2 26	7 17 4 12	3 46 1 08
" " paid up capital,			1 38 1 10	4 69 1 28			
Capital outlay per mile open,	R	207 051 207 583	126 808 127 325	212 366 212 731	67 032 67 196	75 706 79 455	49 003 49,136
Total earnings per mile open per week		607 515	162 132	596 341	150 111	330 236	123 79
Total expenses " "	"	186 164	93 78	260 242	54 54	113 103	58 58
Total earnings per train mile,		5 19 4 73	3 84 3 56	4 37 3 39	3 36 2 68	3 67 3 32	3 64 3 22
Total expenses "		1 59 1 51	2 21 2 11	1 91 2 41	1 22 1 32	1 26 1 44	1 70 2 38
Net earnings "	"	3 60 3 22	1 63 1 45	2 46 0 98	2 14 1 36	2 41 1 88	1 94 0 84

N B —The bracketed figures are respectively for the 1st (January-June) and 2nd (July December) half years of 1894

HEADINGS		East Indian	Indian Midland	Grand Indian Peninsula	Bengal and North Western	Rajputana Malwa	Bhâvnagar Gondal Junâgarh Porbandar
Percentage of total expenses on total earnings		30 67	57 43	43 65	36 93	34 33	46 74
		31 86	59 18	71 18	49 15	43 43	73 92
Ditto (inclusive of steam boat service)		30 75	57 43	43 65	36 50	34 33	46 74
		31 98	59 18	71 18	48 89	43 43	73 89
Coaching train miles run		2 224 237	344 410	1 876 491	364 995	1 062 854	162 073
		2 214 738	348 0 6	1 900 362	406 581	1 089,831	153 989
Average receipts for carrying a 1st class passenger one mile	Pies	15 48	11 17	11 05	20 51	13 63	10 72
		15 55	11 00	11 03	21 10	13 93	10 78
2nd		6 55	4 93	3 49	10 00	6 11	5 15
		6 49	4 47	4 29	9 83	5 97	5 11
3rd		3 52	2 99	3 00	4 83	3 00	
		3 37	2 99	3 00	4 83	3 00	
4th		2 51	2 54	2 42	2 00	2 00	2 75
		2 51	2 54	2 40	2 00	2 00	2 75
Average number of passengers in a train		281 54	189 11	163 05	282 01	274 56	219 79
		235 47	155 58	140 38	220 06	253 57	205 07
Average number of vehicles in a coaching train		20 45	16 91	14 30	27 03	21 02	18 85
		19 91	15 80	13 94	23 60	20 84	16 69
Average weight of a coaching train Freight	Tons	19 54	14 03	12 05	17 76	18 62	14 30
		17 00	11 76	10 46	13 83	17 07	13 21

" , Dead weight, .		232 38	239 99	205 08	161 22	127 31	132 23
		229 44	278 39	201 94	145 09	131 16	121 06
Total,		251 92	254 02	217 13	178 98	145 93	146 53
		246 44	240 15	212 40	158 92	148 23	134 27
Average cost of hauling a coaching train one mile	R	1 01	1 60	1 37	0 92	0 79	1 45
		0 99	1 60	1 92	1 05	0 99	2 06
" " " vehicle "	Pies	10 65	20 53	21 19	6 99	8 20	17 32
		10 76	22 33	30 59	9 25	10 43	27 91
" " passenger one mile,		0 63	1 45	1 41	0 61	0 51	1 21
		0 73	1 75	2 29	0 89	0 70	1 84
Average profit on working a coaching train one mile	R	3 37	1 64	1 29	2 35	2 58	2 05
		2 81	1 17	0 45	1 51	2 12	1 17
" passenger one mile	Pies	2 08	1 40	1 25	1 48	1 61	1 65
		2 02	1 15	0 43	1 21	1 42	1 01
Goods train—miles run, .		3 388 101	481 6 5	3 453,6,0	'11 093	2 842 358	172 841
		3,(88 404	379 220	1 993 593	406 606	2 140 (33	87,427
Average receipts for carrying a ton of goods one mile	Pies	5 01	6 40	8 37	6 38	6 19	11 10
		5 03	7 18	8 36	6 08	6 53	9 27
Average number of tons of goods in a train,		215 17	123 79	119 74	95 94	114 89	63 21
		201 56	110 23	98 12	82 17	98 48	60 94
Average number of vehicles in a goods train,		33 11	29 36	24 25	28 19	25 11	26 78
		30 67	25 34	22 95	25 47	24 91	24 84
Percentage of freight upon capacity hauled,		54 10	40 19	48 43	41 44	66 45	44 27
		53 86	41 38	42 33	40 03	59 01	45 70
Average load of a goods vehicle (including loaded and empty), ...	Tons	6 67	4 49	5 36	3 61	4 75	2 43
		6 76	4 68	4 67	3 45	4 09	2 50
Average load of a loaded goods vehicle, .		9 19	7 17	7 56	4 71	6 25	3 28
		9 41	7 64	6 31	4 54	5 55	3 77
Average weight of a goods train, Freight		215 17	123 79	225 76	95 94	114 89	63 21
		201 56	110 23	188 37	82 17	98 48	60 94

HALF YEARLY STATISTICS OF INDIAN RAILWAYS, 1894—(continued)

HEADINGS		East Indian	Indian Midland	Grand Indian Peninsula	Bengal and North Western	Rajputana Malwa	Bhâvnagar Gondal Junâgarh Porbandar
Average weight of a goods train, Dead weight,	Tons	248 29 239 07	274 23 249 23	219·78 211 47	136·60 125 88	141 59 142 01	120 31 113 80
,, Total, .	,,	463 46 440 63	398 02 359 51	339 52 309 59	232 [illegible] 203 05	256 48 240 49	183 52 174 74
Average cost of hauling a goods train one mile,	R	1 86 1 77	2 50 2 40	2 14 2 80	1 19 1 38	1 39 1 61	1 82 2 68
,, , vehicle ,,	Pies	11 10 11 39	17 42 19 56	18 37 25 55	8 62 11 12	11 02 12 85	13 42 21 15
,, ,, one ton of goods one mile,	,,	1 66 1 68	3 88 4 18	3 43 5 47	2 38 3 22	3 32 3 14	5 53 8 44
Ditto (including interest on capital at 5 per cent),	,,	3 55 3 84	8 05 9 59	5 84 9 62	5 63 7 42	3 91 5 69	10 24 15 65
Average profit on working a goods train one mile,	R	3 76 3 51	1 63 1 72	3 08 1 47	2 00 1 22	2 31 1 74	1 83 0 26
,, , , vehicle ,,	. Pies	22 36 22 66	11 33 14 01	26 48 13 46	14·45 9 86	18 37 13 90	13 51 2 07
,, ,, one ton of goods one mile,	. ,,	3 35 3 35	2 52 3 00	4 94 2 89	4 00 2 86	3 87 3 39	5 57 0 83

Percentage of Working Expenses on Total Earnings							
Maintenance,		8 87	16 12	10 69	9 51	5 84	16 60
		8 72	12 39	19 81	12 27	6 92	25 93
Locomotive expenses		8 00	16 08	17 07	7 40	15 03	12 73
		8 19	18 09	26 73	9 75	17 42	17 18
Carriage and wagon expenses		2 29	3 90	3 70	1 94	3 26	2 40
		2 75	4 72	6 54	2 71	4 99	3 69
Traffic expenses		5 29	7 84	6 95	6 77	5 44	9 06
		6 10	9 34	11 41	9 45	7 22	12 14
General charges,		3 23	7 76	3 00	6 37	4 29	7 93
		3 90	10 07	5 34	8 68	5 96	12 71
Miscellaneous expenses,		2 94	4 83	2 24	1 47	0 47	1 98
		2 13	4 57	1 35	2 29	0 92	2 17
Steam boat expenses		0 13			3 04		
		0 19			3 74		
Total working expenses,		30 75	57 43	43 65	36 50	34 33	46 74
		31 98	59 18	71 18	48 89	43 43	73 82
Maintenance and Renewal of Permanent Way							
Per mile of line maintained,	R	902 49	445 59	861 08	200 34	291 82	310 18
		714 10	204 25	827 59	164 95	208 93	313 99
Per mile of track, including sidings,	"	600 50	392 06	578 30	177 82	253 58	270 96
		476 65	180 39	555 33	146 42	181 42	283 52
Per total train mile,	Annas	4 69	6 34	3 89	2 76	2 09	5 58
		3 98	3 30	5 07	2 45	1 84	2 07
Per 1000 gross ton miles	R	0 77	1 17	0 82	0 82	0 58	2 10
		0 69	0 68	1 21	0 84	0 55	3 30

HALF YEARLY STATISTICS OF INDIAN RAILWAYS, 1894—(*continued*)

HEADINGS		East Indian	Indian Midland	Grand Indian Peninsula	Bengal and North Western	Rajputana Malwa	Bhavnagar Gondal Junâgarh Porbandar
LOCOMOTIVE EXPENSES.							
Per total train mile,	Annas	6 66	10 43	11 93	4 31	8 80	7 41
		6 22	10 30	14 50	4 55	9 11	8 85
Average price per ton of coal,	R	1 89	10 25	12 53	6 31	17 60	20 11
		1 94	9 48	12 55	5 81	16 45	17 46
Coal consumed per train mile,	lbs	54 36	51 46	41 66	29 77	31 12	24 16
		52 94	46 22	42 83	28 38	32 53	26 13
CARRIAGE AND WAGON EXPENSES							
Per total train mile	Annas	1 91	2 40	2 59	1 13	1 91	1 40
		2 09	2 69	3 55	1 27	2 65	1 90
TRAFFIC EXPENSES							
Per total train mile,	Annas	4 40	4 82	4 86	3 94	3 19	5 27
		4 63	5 32	6 19	4 41	3 83	6 25

General Charges							
Per total train mile,	Annas	2 69	.	2 10	3 71	2 51	4 62
		2 95		2 89	4 05	3 16	0 55
Average gross weight of trains, coaching	Tons	169 04		176 73	196 24	102 67	57 27
		166 03		151 50	191 29	101 42	62 30
„ „ „ goods		439 81		280 87	183 67	-16 38	161 63
		418 20		250 04	195 85	197 76	159 55
„ „ „ mixed,	„	236 80			176 52	127 75	121 97
		220 02			147 78	126 42	120 56
Average through speed of trains, coaching,	Miles per hour	25 00		23 02		18 38	20 60
		25 00		22 87		18 38	20 60
„ „ „ goods,	„	12 20		10 98	11 00	9 18	10 69
		12 20		10 51	11 00	9 18	11 11
„ „ „ mixed,	„	17 48		15 19	12 15	13 80	12 26
		17 48		15 47	12 15	13 80	12 50
Average load of passengers,	Miles	63 95		42 41	36·07	53 91	35 45
		62 43		38 72	33 79	53 81	35 81
„ goods,	„	221 89		241 32	110 51	271 90	77 57
		218 08		196 03	107 13	248 20	58 42
Total tonnage of goods lifted	Tons	3 283 310		1 710 495	443 559	1 200,057	136 936
		2,850 422		993,726	311,684	846 833	87,040

APPENDIX VI

EXTRACTS FROM THE NORTH WESTERN RAILWAY'S COACHING TARIFF

Schedule of Maximum and Minimum Fares and Rates for Coaching Traffic applicable to the North Western Railway under the orders issued in the Government of India Resolution No 563 R T, dated the 16th July 1891, as modified by the Government of India Circular No 11 Railway, dated the 14th December 1896

	Maximum pies per mile	Minimum pies per mile
Passenger Fares—		
1st Class,	18	12
2nd Class,	9	6
Intermediate Class,	$4\frac{1}{2}$	3
3rd Class,	3	1

	Maximum pies per mile.	Minimum pies per mile
Carriages*—		
Single Carriages,	42	30

	Maximum pies per truck	Minimum pies per truck
Two or more carriages on one truck,	54	42

	Maximum pies per mile	Minimum pies per mile
Horses*—		
Single Horse,	24	18

	Maximum pies per fifty miles or portion thereof	Minimum pies per fifty miles or portion thereof
Dogs—		
Each,	96	48

Luggage, Parcels, and Bullion—

The Rates passed at the Railway Traffic Conference of 1893, which are as under —

Parcels and Luggage—

(a) Parcels shall be charged by either weight or measurement, whichever [illegible] being considered equal to [illegible] asurement, or five seers in [illegible]

(i) When the weight does not exceed two and a half seers, four annas per 500 miles or fraction of 500 miles, subject to a maximum charge of one rupee

* Subject to a minimum *charge* of Rs 5
† 40 seers = 1 maund = 8[illegible] pounds

When the weight does not exceed five seers four annas per 250 miles or fraction of 250 miles subject to a maximum charge of two rupees.

(d) —

such re booki g sta to and o n su book n g s atio to destination —

Rat List fo L ggag a P r

Distances in Miles		Rs	a	p	Rs	a	p	Rs	a	p	Rs	a	p	
Not exceeding	5		4		0	4	0	0	4		0	4	0	The amounts entered in the respective columns
Exceeding ... but not exceeding	50	0	4	0	0	4	0	0	8	0	0	8	0	
50	100		4	0	0	8	0	0		0	1	0	0	
100	150	0	8	0	0	1	0	1	0	0	1	8	0	
150	300		8	0	1	0	0	1	8	0		0	0	
300	450	0	1	0	1	8	0	2	4	0	3	0	0	
450	600	1	0	0		0	0	3	0	0	4	0	0	
6/8	50	1	4	0	2	4	0	3	1	0		0	0	
[illegible]	900	1	6	0	2	12	0	4	2	0	5	8	0	
900	1 0	1	9	0	3	2	0	4	1	0	6	4	0	
1 0.0	1 ?00	1	1	0	3	8	0	5	6	0	7	[illegible]	0	
1 200	1,333	2	0	0	4	0	0	6	0	0	8	0	0	
1 333	1 500	2	4	0	4	8	0	6	12		9	0	0	
1 500	1 666		8	0	5	0	0	7	8	0	10	0	0	
1 666	1 833	[illegible]	12	0	5	8	0	8	4	0	11	0	0	
1 833	2,000	3	0	0	6	0	0	9	0	0	1	0	0	
2 000	2 166	3	4	0	6	8	0	9	1	0	13	0	0	
2 166	2 333	3	8	0	7	0	0	10	8	0	14	0	0	
2 333,	2 500	3	1	0	7	8	0	11	4	0	15	0	0	
2 500	2 666	4	0	0	8	0	0	12	0	0	16	0	0	
2 666	2,833	4	4	0	8	8	0	1	1?	0	17	0	0	
2 833	3 000	4	8	0	9	0	0	13	8	0	18	0	0	
For each additional 16 or part of 167 miles beyond 3000 miles		0	4	0	0	8	0	0	1	0	1	0	0	

(e) Pa

packages

Passengers, Classes, and Fares.

24 Classes of Fares on N W. Railway —There are four classes of ordinary passenger accommodation on the North Western Railway for which the fares * are as follows —

	North Western Railway generally.	Mushkaf Bolan and Sind Pishin Lines.
1st Class	1 anna per mile	18 pies per mile.
2nd Class	6 pies ,,	9 ,, ,,
Intermediate Class,	3 ,, ,,	4½ ,, ,,
3rd Class,	2¼ ,, ,,	3 ,, ,

Luggage Rates and Rules

99 Passengers' Luggage and Free Allowance —On all railways all packages of whatever description (except specie or bullion, *vide* para 162*k*) taken as passengers' luggage will be weighed, and *the following quantities allowed free* of charge —

For each 1st Class passenger,	. . .	60 seers
,, 2nd ,,	. . .	30 ,,
,, Intermediate Class passenger,	. .	20 ,,
,, 3rd Class passenger,	. .	15 ,,

Half the above quantity for a child's half ticket

See also paras 66 *d* to *f* and 103

(a) On all [illegible] Nizam's

EXTRACTS FROM THE NORTH WESTERN RAILWAY'S GOODS TARIFF

Schedule of authorised Maxima and Minima Rates for Goods Traffic applicable to the N W Railway under the orders issued by Government of India in Public Works Department Resolution No 563 R T, dated 16th July 1891, as modified by Government of India Circular No 11 Railway, dated 14th December 1896

Classes	Pies per maund per mile.	
	Maximum	Minimum
5th,	1	
4th,	$\frac{5}{6}$	
3rd,	$\frac{2}{3}$	$\frac{1}{6}$
2nd,	$\frac{1}{2}$	
1st,	$\frac{1}{3}$	
Special,	$\frac{1}{5}$	$\frac{1}{10}$
Explosives,	$1\frac{1}{2}$	$\frac{1}{6}$

N B —One pie may be taken as one twelfth of a penny, and one maund as 82 29 pounds avoirdupois (there being 27 22 maunds to 1 ton)

* Referred to in Chap VIII p 170

GENERAL RULES

3 Published Rates —The rates quoted in the rate lists herein and in the printed sheets exhibited at stations are from any one station to any other station and are inclusive of all charges except in special cases, where the rail- ... extra services The rates can be ascertained from ... lasters, and from ... Superintendents, ... d Kurrachee ... conveyed at the ... ted by the railway ... nt, or the several ... mer is required to

... quired to be ... count of the ... these duties a charge of ... per maund or

... will be charged ... dinary stock are quoted

RATES AND RULES FOR LOCAL AND THROUGH BOOKING

34 General Quotation of Rates —The N W Railway has through booking arrangements with certain mentioned railways, all of which quote a rate per maund per mile

35 Route by which Traffic ...

... Railway has entire command of a ... stations, it may send the traffic by ... public does not exceed that by the shortest route

36 Fixed Rates on N W Railway —Goods are conveyed on the North Western Railway under different rates of freight according to their classification.

These rates* are as follows:—

Special Class Goods at		⅙ pie per maund per mile.		
1st	,,	,,	¼	,, ,,
2nd	,,	,,	⅓	,, ,,
3rd	,,	,,	½	,, ,,
4th	,,	,,	⅞	,, ,,
5th	,,	,,	1	,, ,,
Explosive or X		,,	1½ pies	,, ,,

... there are other special rates which ...

of 6 pies per maund is ...

* Referred to in Chap VIII, p 171.

signments of 2nd 3rd 4th 5th and explosive class goods and 3 pies per maund upon special and 1st class goods

39 Terminal Charges in Through Traffic —In through booking with foreign lines a terminal charge of 3 pies per maund is added to the actual mileage rates upon all classes of goods except on cross traffic i e traffic passing through junctions.

40 Special Terminal on Traffic between Kotri and Kurrachee City —In calculating rates for booking between Kotri (including Kotri Bandar) and Kurrachee City or Keamari 12 miles extra are added to the actual distance to and

10 seers 20 5 lbs Avoirdupois
8 9 lbs Avoirdupois—1 md (divided into 40 seers)
2 ?? maunds 1 ton
100 3 6 3 tons

44 Combined Rule —Except where otherwise specified when in consequence

lower charge may be in force

NOTE —This rule also obtains on certain other railways On two it applies when specially notified to be combined On one it applies to weight only

MINIMA CHARGES AND METHOD OF CALCULATING FREIGHT

seers is tendered for despatch by goods train it will be refused as *goods* but will be accepted with the consent of the consigner as a *parcel* and booked as such by passenger train

II.
III.
IV
V are

charged as ¼ maund but subject to rules and (a) thus —
14 seers are charged for as ½ maund.
26 ¾
121 3¼ maunds and so on

* Referred to in Chap II p 14

MINERALS

113 Mineral Class Goods on N W Railway —All mineral class goods (other than coal coke and patent fuel) consigned in full wagon or truck loads (see para. 31) will be carried at the following rates according to the distance they are carried over the North Western Railway —

[illegible] pie per maund per mile for distances below 100 miles
[illegible] pie per maund per mile for distances over 100 miles and below 300 miles
[illegible] pie per maund per mile for distances 300 miles & above
} Subject to the differential rule

Owners to load and unload If the railway has to do this 3 pies per maund will be charged for each operation

Minerals packed in bags in smaller quantities 1st class rate on actual weight for the distance carried.

NOTE.—Minerals unpacked in smaller quantities will not be accepted for carriage over the N W Railway

Minerals charged at the 1st class rate will be loaded and unloaded by the railway

RATES AND CONDITIONS FOR THE CARRIAGE OF COAL COKE AND PATENT FUEL FOR THE GENERAL PUBLIC

[illegible]

(b) *Consignments in full wagon loads—*

	Per maund per mile.
[illegible] 400 miles and above	0 15 pie.
[illegible]	0 15
[illegible]	0 10

[illegible]

50 000 up to	200 000	2½ per cent.
200 000	400 000	5
400 000	600 000	7½
600 000	800 000	10
800 000		15

The rebate under this scale will be limited to 10 per cent of the total quantity carried

127 Rebate on Aggrega
over the Home Line —At th
aggregate consignments to o
shall have exceeded 50,000
ments made in accordance with the followin scale —

On quantities in excess of—

Mds		Mds	Rebate
50 000	up to	200 000	2½ per cent
200 000	,	400,000	5 ,,
400,000	,	600 000	7½
600 000	,,		25

The rebate under this scale will be limited to 15 per cent of the total quantity of coal carried.

129 All charges for loading and unloading coal into and from railway wagons as well as those for transhipment at ferries or otherwise shall be at the entire cost of the consigners and consignees, and will be in addition to the rates herein prescribed

When it is necessary for the railway to load or unload a charge of 3 pies per maund will be made for each operation

APPENDIX VII

No 514 R C of 1896

GOVERNMENT OF INDIA

PUBLIC WORKS DEPARTMENT

RAILWAY CONSTRUCTION

Simla, the 17th April 1896

Terms on which the Government of India are prepared to consider offers for the construction by the agency of private companies of branch lines forming feeders either to State lines worked by the State or to railways worked by companies

Read—

Public Works Department Resolution No 924 R C, dated 15th September 1893

The Government of India have accordingly resolved to cancel the previous Resolutions above quoted upon this subject and to issue a fresh Resolution em

2 Proposals for the construction of branch lines under this Resolution must conform to the following terms and conditions

(i) Applicants must satisfy the Government that they are in a position to command substantial financial support

(ii) The gauge to be adopted must be approved by the Government in each case

(v)

(vi) Inasmuch as these railways are chiefly required for the developme t of

(a) It may be stipulated tl at after the opening of tl e railway for traffic

Under (a) t e company will receive an absolute guarantee of inte est at a rate not exceeding 3 per cent. and a higl er return if the net earnings of the branch are sufficient to pay more than the gua an eed divi lend.

may be agreed upon The minimum dividend to be guaranteed in each particular case will depend upon consideration of the circumstances but for the present no offer will be entertaine l tl at requires a guarantee exceeding 3 j er cent. or

(b) It may be provided that a payment be made to tl e branch company

Under (b) tl e company will recei e a dividend of 3½ per cent provided that the amount of the net earn ngs from local and inte changed traffic be s fficient and a higher eturn if the net earnings of the branch from i s own traffic be sufficient to pay a higher d vidend

branch comj any a u v ue u v vj j er cent j er annum on the actual expenditure charged in the capital account of the branch railway com j any as entered in rupees in tl e company s books in India provided always that the j ayment so made to the branch company shall in no case exceed the net earnings of the main line from
nted
ent
int
e of
ron
me
ffic
ear
nch
as
above the whole of such earnings will go to the branch company

In either of the above cases (a) or (b) if the capital is raised in sterling the

(a) No caj ital expenditure by the branch ra lway company will be allowed as between the Secretary of State and the company unless

the prior sanction of the Secretary of State shall have been obtained The company shall have no power to increase its share or stock capital without the sanction of the Secretary of

(b)

(viii.) Fr ... ble to capital, ... ned to public ... Such works ... ranch railway

company ...
hand In
branch rail
necessity fc
referred to the Director General of Railways as arbitrator, and his decision shall be final

works

(4) The results of existing survey

under paragraph 2
is part of
entage of

ch Line
Company

(7) Railway materials for the branch railway will be carried over State lines at the special rates prescribed for such materials belonging to State railways

4. The Government of India reserve the right to purchase all such branch
subsequent intervals of 10 years on 12
times the yearly average net earnings
years preceding the purchase, with a
100 per cent of cost price on a rupee
basis

5 The Government also reserve—

(i) The right to fix and vary from time to time the classification of goods and maximum and minimum rates for each class of goods, as well as of passengers, and

The Governments of Madras Bombay Bengal the North Western Provinces and Oudh and the Punjab
The Chief Commissioners of the Central Provinces Burma and Assam

ORDER —Ordered that this Resolution be forwarded for information to the Local Governments and Administrations and to the officers marginally noted

Also that it be published for general information in the *Gazette of India*

W S S BISSET *Col, R E,*
Secretary to the Government of India

Documents Accompanying

and C

Enclosure No 1 (with Form A and Appendices A B and C) to Government of India Resolution No 514 R C of 1896

MEMORANDUM A

For the guidance of persons or syndicates desirous of submitting proposals for the construction of branch railways in India forming feeders either to State lines worked by the State or to railways worked by companies

of each share,

(b) all the termini together with the names of all the principal towns from, through into or near which the railway is intended to be constructed as well as the names of each civil division and district to be traversed by the proposed alignment

(g) the proposals for working the railway when constructed and if any

struction of which the Government is prepared to entrust to companies, and copies of such plans, sections, and estimates will be furnished on payment of the cost of copying

7. But in regard to all such information statistics, plans sections or esti

FORM A.

To accompany all applications for leave to construct a branch or feeder railway in any part of British India

	Nature of particulars to be specified	Particulars
1	The name of the Company, person, or persons by whom the application is preferred, the proposed amount of capital, the number of shares, and the amount of each share	
2	[illegible]	*Reference to an Appendix* (vide *Appendix A*) *may be here given if necessary*
3	The length, as far as known, of the proposed railway	
4	The gauge proposed and weight of rails &c	
5	The motive power to be employed	
6	The maximum tolls, rates and fares intended to be charged on the proposed railway	*Reference to an Appendix* (vide *Appendix B*) *may be here given if necessary*
7	Details of any agreement which may have been provisionally arranged, or which it is desired to enter into, under which the proposed line, when constructed, is to be leased out for working to any existing Railway Administration	*Reference to an Appendix* (vide *Appendix C*) *may be here given if necessary*
8	Any further information that may be required to enable the Government of India to thoroughly understand the scope of the proposals	

APPENDIX A

ALIGNMENT OF PROPOSED BRANCH RAILWAY.

From ______ — to ______

Principal towns and districts or provinces through which the projected railway will pass

Towns	Districts or Provinces

APPENDIX B

Schedule of maximum and minimum rates and fares intended to be charged on the proposed branch railway

	Maximum Pies per mile	Minimum Pies per mile
Passenger Fares—		
1st class,		
2nd class		
Intermediate class		
3rd or lowest class		

	Maximum Pies per maund per mile	Minimum Pies per maund per mile
Luggage		

	Maximum Pies per mile	Minimum. Pies per mile
Carriages—		
Single carriage,		

	Maximum Pies per truck	Minimum Pies per truck
Two or more carriages on one truck,		

	Maximum Pies per mile	Minimum Pies per mile
Horses—		
Single horse,		

	Maximum Pies per 50 miles or portion thereof	Minimum Pies per 50 miles or portion thereof.
Dogs—		
Each,		

	First 100 miles Annas	Every additional 100 miles Annas
Parcels—		
Not exceeding 5 seers or 1 cubic foot,		
,, ,, 10 ,, 2 cubic feet,		
,, ,, 20 ,, 4 ,,		
,, ,, 30 ,, 6 ,,		
,, ,, 40 ,, 8 ,,		
For every additional 10 seers or 2 cubic feet, or portion of 10 seers or 2 cubic feet,		

	Maximum Pies per maund per mile	Minimum Pies per maund per mile
Goods rates—		
5th class,		
4th ,,		
3rd ,,		
2nd ,,		
1st ,,		
Coal edible grain and other low priced staples to be carried at special rates,		

APPENDIX C

Working of proposed branch railway

No agreement has yet been arranged with any existing Railway Administration under which the projected branch railway is to be worked but when completed it is proposed to offer the working to the Railway Company on the following terms —

(i) — — —

(ii) —

(iii) &c

Or

It has been provisionally arranged with the — Railway Company to work the projected branch railway, when completed on the following terms —

(i)

(ii) —

(iii) &c

Enclosure No II to Government of India Resolution No 514 P C of 1896

MEMORANDUM B

of having surveys for branch
their expense by the Public

3 Every such application shall be accompanied by a map to a scale of 1 mile to 1 inch with the line of the proposed survey delineated thereon so as to

cost of copying

6 But in regard to all such information statistics plans sections, or estimates which may be furnished it is to be recognised that the information thus offered to any person interested in the matter is simply the best information of the kind at the disposal of Government and that Government cannot accept any responsibility whatever in regard to the accuracy of any of the documents

APPENDIX VIII

LIGHT RAILWAYS ACT 1896
[59 & 60 Vict Ch 48]

Arrangement of Sections

parish that during a period not exceeding ten years to be fixed by the order so much of the railway as is in that parish shall not be assessed to

may authorise the Board of Trade to extend any such period

made on such conditions and at such rate of interest as the Treasury direct

6 Limitation on amount of advance and provision of money by National D C T T

(2) The National Debt Commissioners may lend to the Treasury and the Treasury may borrow from the National Debt Commissioners such money as may

Consideration of application by Light Railway Commissioners.—(1)

rules made under this Act

(3) The Commissioners shall before deciding on an application give full opportunity for any objections to the application to be laid before them, and shall consider all such objections whether made formally or informally

(4) If after consideration the Commissioners think that the application should be granted they shall settle any draft order submitted to them by the applicants

for and working the railway and see that all such matters (including provisions for the safety of the public and particulars of the land proposed to be taken) are inserted therein, as they think necessary for the proper construction and working of the railway.

(5) The order of the Light Railway Commissioners shall be provisional only, and shall have no effect until confirmed by the Board of Trade in manner provided by this Act.

(6) Where an application for a light railway has been refused by the Light [illegible]

8. Submission of orde[illegible] missioners shall submit [illegible] Trade for confirmation, [illegible] required by the Board a[illegible] order, a report stating th[illegible] and the manner in which [illegible] reference to the order wh[illegible] [illegible]

objections must be lodged.

9. Consideration of order by Board of Trade.—(1) The Board of Trade shall consider any order submitted to them under this Act for confirmation with special reference to—

[illegible]

Bo[illegible]
Bo[illegible] or any objection thereto.

(3) If the Board of Trade on such consideration, are of opinion that, by reason of the magnitude of the proposed undertaking, or of the effect thereof on the [illegible]

[illegible] ard of Trade may [illegible]

[illegible] may contain provisions for [illegible] purposes—

(a) the incorporation, subject to such exceptions and variations as may be

respect to the purchase and taking of land otherwise than by agreement and

y of the
g enact
to the

ailway
mpanies

for the purpose and

(d) giving any railway company any power required for carrying the order into effect and

and

(g) authorising a council to advance or borrow money for the purposes of the railway and limiting the amount to be so advanced or borrowed and regulating the terms on which any money is to be so advanced or borrowed and

(h) the manner in which the profits are to be divided where an advance is made by a council to a light railway company as part of the share capital of the company and

(i) the proper audit of the accounts of the managing body of the railway where the managing body is not a local authority and the time within which the

and

(l) empowering any local authority to acquire the railway and

(m) any other matters whether similar to the above or not which may be considered ancillary to the objects of the order or expedient for carrying those objects into effect

13 Mode of settling purchase money and compensation for taking of land —(1) Where any order under this Act incorporates the Lands Clauses Acts any matter which under those Acts may be determined by the verdict of a jury by

hereditaments belonging to the same proprietor may be benefited by the proposed light railway

(2) The Board of Trade may, with the concurrence of the Lord Chancellor, make rules fixing a scale of costs to be applicable on any such arbitration, and may, by such rules, limit the cases in which the costs of counsel are to be allowed

(3) The Arbitration Act 1889 (52 & 53 Vict c 49), shall apply to any

hundred pounds

15. Provisions as to Board of Trade (37 & 38 Vict c 40) —(1) If the Board

and

(b) the parties making

way, and in the c

made to any suc

addition, were par

3 of the Act

(2) The Board of Trade may make such rules as they think necessary for regulating the procedure under this Act, whether before the Board of Trade or

missioners with

Health Acts

may raise the money

(a) if the expenditure is capital expenditure, by borrowing in manner authorised by the order, and

and

(b) l necessary, of any of the to this Act (bei g enact inies with respect to the

(c) givii g the necessary powers for constructing and working the railway, including power to make agreements with railway and other companies for the purpose and

(d) giving any railway company any power required for carrying the order into effect and

and

(g) authorising a council to advance or borrow money for the purposes of tl e railway and limiting the amount to be so advanced or borrowed and regulating the terms on which any money is to be so advanced or borrowed and

(h) the manner in which the profits are to be divided where an advance is made by a council to a light railway company as part of the share capital of the company and

(i) the proper audit of the accounts of the managing body of the railway where the managing body is not a local authority and the time within which the railway must be constructed and

(j) fixing the maximum rates and charges for traffic, and

(k) in the case of a new company requiring the company to make a deposit and providing for the time of making and tl e aj lication of the deposit, and

(l) empowering any local authority to acquire the railway, and

(m) any other matters whether similar to the above or not wl ich may be considered ancillary to the objects of the order or expedient for carrying those objects into effect

that no duties shall hereafter be levied in resp ect of passengers conveyed on a light railway constructed under this Act in respect of the conveyance of such passengers upon such railway

13 Mode of settling purchase money and compensation for taking of land —(1) Where any order under this Act incorporates the Lands Clauses Acts, any matter which un ler those Acts may be determined by the verdict of a jury, by

(2) The Board of Trade may, with the concurrence of the Lord Chancellor, make rules fixing a scale of costs to be applicable on any such arbitration, and may, by such rules, limit the cases in which the costs of counsel are to be allowed.

(3) The Arbitration Act 1889 (52 & 53 Vict c 49), shall apply to any arbitration under this section.

14. Payment of purchase money or compensation —Any order under this Act may, notwithstanding anything in the Lands Clauses Acts, authorise the payment to trustees of any purchase money or compensation not exceeding five hundred pounds

and

(b) th

3 of the Act

(2) The Board of Trade may make such rules as they think necessary for regulating the procedure under this Act, whether before the Board of Trade or

(*b*) if the expenditure is not capital expenditure, as if it was on account of the expenses of an application under this Act

(3) The Board of Trade may from time to time, on the application of any council, extend, subject to the limitations of this Act, the limit of the amount which the council are authorised by an order under this Act to borrow, or to advance to a light railway company, and the limit so extended shall be sub

for the

exceed

(5)

applied in aid of the rate out of which the expenses of the council in respect of the light railway are payable

under this Act, the

Local Govern

gh, or district

order

work

such a

c 41),

ay be,

ointed

mittee

cts to

t shall

apply

18 Working of ordinary railway as light railway —Where a company have

order under

a light

ailway

—(1) Where any person has power, either by statute or otherwise, to sell and convey any land for the purpose of any works of a light railway, he may, with the sanction of the Board of Agriculture given under this section, convey the land for that purpose either without payment of any purchase money or compensation or at a price less than the real value, and may so convey it free from all incumbrances thereon

(2) Whenever any person who is a landowner within the meaning of the

... no easement over or affecting any common shall be purchased taken or acquired under this Act without the consent of the Board of Agriculture and

...

the land taken and where a common is divided to secure convenient access from one part of the common to the other

...

(a) the amending order may be made on the application of any authority or person and

(b) the Board of Trade in considering the expediency of requiring the ... shall

... railway

... ent" in ... orising

a light railway ...

26 Application to Scotland —This Act shall apply to Scotland with the following modifications —

(1) In section 5 of this Act the expression "Secretary for Scotland" shall be substituted for the expressions "Board of Agriculture" and "Board of

...

councils may ...

(3) "Arbiter" shall be substituted for "arbitrator" and that arbiter shall be deemed to be a single arbiter within the meaning of the Lands Clauses Acts

and in lieu of the provisions of the Arbitration Act, 1889, the provisions of

an arbitration shall apply, except the

xpenses of the arbitration, in lieu of

effect, namely, the expenses of the

e in the discretion of the arbiter, who

it manner those expenses, or any part

ttle the amount of expenses to be so

expenses to be paid as between agent

and client

(4) The Lord President of the Court of Session shall be substituted for the Lord Chancellor ,

(5) The money necessary to defray expenditure, not being capital expenditure, incurred by a county council in pursuance of this Act, shall be raised by a rate imposed along with but as a separate rate from the rate for maintenance of

nses, being

to district

following

modifications—

(a) A district committee shall not be

section two hereof except with th

a special or statutory meeting

special notice setting forth the

sent to each councillor,

(b) A resolution to give such consent shall not be passed by the council unless two thirds of the councillors present and voting at the special or statutory meeting concur in the resolution,

(c) Nothing in this Act shall authorise a district committee to raise money by rate or loan, but any money necessary to defray expenditure, not being capital expenditure incurred by it in pursuance of this Act, shall be raised by the county council by a rate imposed along with but as a separate rate from the road rate, and any money necessary to defray capital expenditure shall be raised by the county council by borrowing in the manner authorised by the order, as in section sixteen hereof mentioned,

whichever is less ,

23 Definitions.—In this Act, unless the context otherwise requires,—

SCHEDULES

FIRST SCHEDULE (Section 3)

Mode of Passing Special Resolutions

1 The resolution approving of the intention to make the application must be passed at a meeting of the council

2 The resolution shall not be passed unless a month's previous notice of the resolution has been given in manner in which notices of meetings of the council are usually given

3 The resolution shall not be passed unless two thirds of the members of the council present and voting concur in the resolution

SECOND SCHEDULE (Section 12)

Enactments relating to Safety, etc

Session and Chapter	Title or Short Title	Enactment referred to
2 & 3 Vict c 45	An Act to amend an Act of the fifth and sixth years of the reign of his late Majesty King William the Fourth relating to highways	The whole Act
5 & 6 Vict c 55	The Railway Regulation Act 1842	Sections four, five, six nine ten
9 & 10 Vict c 57	An Act for regulating the gauge of railways	The whole Act
31 & 32 Vict c 119	The Regulation of Railways Act 1868	Sections nineteen twenty, twenty two twenty seven twenty eight and twenty nine.
34 & 35 Vict c 78	The Regulation of Railways Act, 1871	Section five
36 & 37 Vict c 76	The Railway Regulation Act (Returns of signal arrangements, working etc) 1873	Sections four and six
41 & 42 Vict c 20	The Railway Returns (Continuous Brakes) Act 1878	The whole Act
46 & 47 Vict c 34	The Cheap Trains Act, 1883	Section three
52 & 53 Vict c. 57	The Regulation of Railways Act, 1889	The whole Act

THIRD SCHEDULE (SECTION 17)

JOINT COMMITTEES

(e)

(f)

(g) The [illegible]
casting vote

(h) The quorum proceedings, and place of meeting of a committee, whether within or without the area within which the committee are to exercise their authority, shall be such as may be determined by regulations jointly made by the councils appointing the committee, and in the event of their differing in opinion as may be determined by the Board of Trade on an application by either council

(i) Subject to those regulations the quorum, proceedings, and place of meeting whether within or without the area within which the committee are to exercise their jurisdiction, shall be such as the committee direct

APPENDIX IX.

STATUTORY RULES AND ORDERS, 1896

No 787

RAILWAY

Light Railway

Rules dated September 1896 made by the Board of Trade with respect to Applications to the Light Railway Commissioners for orders authorising Light Railways *

Notice of Proposed Application.

1 Notice by advertisement —Notice of intention to apply to the Light Railway Commissioners for an order authorising a light railway, or for an amending order, must be published by advertisement in each of two consecutive weeks in

he Light

the plan
and book of reference and section and of the estimate hereinafter mentioned
of May or of November,
ish, district and parish
parish any part of the
inspection during office
hours

With the above documents there must also be deposited a sheet or sheets of the ordnance map, on a scale of not less than one inch to a mile, with the line of railway indicated thereon, so as to show its general course and direction

---

* *Note* —These Rules will regulate the procedure before the Light Railway Commissioners where a scheme for a light railway has been matured and it is intended to make a formal application for an order

The Commissioners will at all times be prepared to give every facility in their power for considering and maturing proposals for the construction of light railways to be submitted to them

4 Deposits with Government Departments.—Copies of the draft order and of
uring the month
f the draft order
eneral the Com-
the War Office,
th the Secretary

ules 1 and 3, in
r the month of

Plans, Book of Reference, and Sections

5 Plans.—Every plan must be drawn to a scale of not less than four inches to the mile, and must describe the lands intended to be taken, and the line or situation of the whole of the railway (no alternative line or work being in any

hundred feet

8 Distances to be marked.—The distances from one of the termini must be shown in miles and furlongs on the plan, and a memorandum of the radius of every curve not exceeding one mile in length shall be noted on the plan in

any public carriage road, course of such diversion and the extent of such widening or narrowing shall be marked on the plan

scale as the plan and to a vertical one hundred feet, and shall show the surface of the ground marked on the plan, the

one of the termini of the railway

In every section the line of the railway marked thereon shall correspond with the upper surface of the rails

15 Vertical measures to be marked at change of gradient —Distances on the datum line shall be marked in miles and furlongs to correspond with those on the plan a vertical measure from the datum line to the line of the railway

be unaltered

ence to the numbers on a horizontal scale of not less than one inch to every three hundred and thirty feet and on a vertical scale of not less than one inch to every forty feet shall be added which shall show the present surface of such road canal or railway and the intended surface thereof when altered and the greatest of the present and intended rates of inclination of the portion of such road or railway intended to be altered shall also be marked in figures thereon and where any public carriage road is crossed on the level a cross section of such road shall also be added and all such cross sections shall extend for two hundred yards on

tunnel

section

Notices to Owners Lessees and Others

21 Service of notices on landlords and others —During the month of April or of October the promoters must serve a notice on the owners or reputed

such lands and requesting him to state any objections he may have to such lands being taken

Every such notice shall be as nearly as may be in the form set out in the schedule to these Rules

on the road authority (where other than a county borough district or parish council of any road or street along which it is proposed to lay any rails or which will be otherwise interfered with by the proposed railway and such notice shall
s of the proposed railway has or

this Rule and of Rule 21 in the
be substituted for the month of

October

company

Estimate

26 The estimate shall be in the following form, or as near thereto as circumstances may permit —

Estimate of the proposed Light Railway.

			Whether Single or Double.	
Lines No . . .	miles fgs chs			
Length of line . . .				
Gauge . . .	Cubic Yards.	Price per Yard.	£ s d	£ s d.
Earth works:				
Cuttings—Rock .				
Soft soil . .				
Roads . .				
Total . .				
Embankments, including roads . .	Cubic yards			
Bridges—Public roads . .	Number			
Accommodation bridges and works . .	. .	.		
Viaducts	. .	.		
Culverts and drains . . .	. .	.		
Metallings of roads and level crossings .	.			
Gatekeepers' houses at level crossings .				
Permanent way, including fencing miles fgs chs at	Cost per mile £ s d			
Permanent way for sidings, and cost of junctions .		.		
Stations	.	.		
Contingencies	Per cent	.	.	
Land and buildings a. r p				
Total . .			£	

The same details for each branch, and general summary of total cost

Application to the Commissioners

27 Documents to accompany application.—Every application to the Commissioners for an Order must be made in the month of May or of November except in the year 1896, when it must be made in the month of December, and must be in the case of a corporate body under the seal of such body, and in any other case signed by the promoter or promoters, or if there are more than two, then by any three of them, and must be accompanied by—

(1) a copy of the advertisement of the intention to apply for the order,

... of the draft order and of each of the documents required by

... and
occupiers on whom notices have been served, and a statement as far as can then be made whether in each case they assent, dissent, or are neuter.

General Provisions as to Notices

oo Authentication, etc., of notices.—Notices and other such documents ... or partly in writing and partly in ... ted if signed by the clerk of the ... many or by the promoter or any ... If the notice or other document is

served. ... of notices.—Notices and any other documents required or author...

... further name or description.

Fees

... of Trade.—Before lodging any application ...

General

31 All communications to the Commissioners should be on foolscap paper and written on one side only, and should be addressed to—

The Secretary,
Light Railway Commission,
23 Great George Street,
London, S.W.

32 In the case of an application for an amending order, such of the requirements of these Rules as are inapplicable will be dispensed with

33 These Rules shall remain in force until modified by the Board of Trade

The Board of Trade
September 1896

COURTENAY BOYLE,
Secretary

SCHEDULE.

Form of Notice to Landowners and others

SIR,

WE beg to inform you that application is intended to be made to the Light Railway Commissioners for an order authorising a light railway from to , and that the property mentioned in the annexed schedule or some part thereof, in which we understand you are interested as

set forth in the annexed schedule

[illegible] description in the annexed schedule we shall feel obliged by your informing us thereof at your earliest convenience, that we *may correct the same without* delay

We are, &c.,

Schedule referred to in the foregoing notice describing the property therein alluded to —

	Parish, Township Townland or extra parochial Place	Number on Plans	Description	Owner	Lessee	Occupier
Property on the line of the proposed work or within the limits of the deviation intended to be applied for						

I the undersigned assent to [dissent from] my property being taken for the proposed work [and my objections are that]

APPENDIX X

GENERAL ENACTMENTS RELATING TO RAILWAYS REFERRED TO IN SECTION 12 (2) OF THE LIGHT RAILWAYS ACT, 1896, AND NOT PREVIOUSLY NAMED IN CHAP XI

Carriers Protection Act, 1830 (1 Will IV c 68)
[This Statute (11 Geo IV & 1 Will IV c 68) protects "common carriers for

1876]

Conveyance of Mails by Railways, 1837 (1 & 2 Vict c 98)

Regulation of Railways Act, 1840 (3 & 4 Vict c 97)
[This Statute deals with returns to be made by the company, bye laws, branch railways, etc]

Regulation of Railways Act, 1844 (7 & 8 Vict c 85)
[Tolls, Board of Trade prosecutions, cheap trains, etc]

Documentary Evidence 1845 (8 & 9 Vict c 113)

Railway Clearing System, 1850 (13 & 14 Vict c 33)

Abandonment and Dissolution of Railways 1850 (13 & 14 Vict c 83)

Railway and Canal Traffic 1854 (17 & 18 Vict c 31)
[Traffic facilities undue preference through traffic, special contract as to goods and animals]

Railway Companies Arbitration Act, 1859 (22 & 23 Vict c 59)

Lands Clauses Consolidation Act (Amendment), 1860 (23 & 24 Vict c 106)

Railway Companies Powers 1864 (27 & 28 Vict. c 120)

Railway Companies Securities Act, 1866 (29 & 30 Vict c 108)
[Loan capital account to be kept open to inspection, etc]

Lands Clauses Consolidation Act (Amendment), 1869 (32 & 33 Vict c. 18)

Abandonment of Railways, 1869 (32 & 33 Vict c 114)

Railways (Powers and Construction) Amendment Act, 1870 (33 & 34 Vict c 19)

Railway Rolling Stock Protection Act, 1872 (35 & 36 Vict. c 50)

Railway and Canal Traffic, 1873 (36 & 37 Vict c 48)

Contagious Diseases (Animals) 1878 (41 & 42 Vict. c 74)

Commonable Rights (Compensation), 1882 (45 Vict c. 15)

Post Office (Parcels), 1882 (45 & 46 Vict c 74)

Railway and Canal Traffic, 1888 (51 & 52 Vict c. 25)

SUPPLEMENTARY NOTE ON THE COLONIES.

There are generally so few obstacles in the way of cheap construction and simple methods of working in the Colonies, wherever the utmost economy is essential, that light railways are frequently built without being specially classed as such. Thus, the office (in London) of the Agent General for Western Australia would probably inform an enquirer that the government of that colony have not adopted the system of light railways; and, indeed, a country which has constructed 830 miles of 3 feet 6 inch gauge railway at a cost of not more
a separate system of
ilway development in
ble from the London
office and the cost per mile of railway on both gauges (5 feet 3 inches and 3 feet 6 inches) may average as much as £7364, but extensions on the broader gauge were actually made on light railway principles more than thirty years ago. The cost per mile of railways in Queensland is less, but the government of that colony last year deputed their chief engineer to visit and report on light railways in Europe and America. The average cost of railways in Victoria is about £12,250 per mile, and a trial of light railways is being made in one or two of the outlying districts. The Mallee extensions in Victoria may not individually show a profit, but they act as feeders to main lines, they contribute to the general revenue, they have encouraged the settlement and the cultivation of an increased area, the traffic is growing,
... The cost of railways in New
but lines of the
at a cost of only
the 3 feet 6 inch
cost per mile of
2253 miles of railway, on the same gauge, in Cape Colony is (quoted by the Minister of Railways, New Zealand, 1898, Return No. 15, at)

so called, other than tramways.

In Canada, during the warmer season of the year from April to

November, waterway communication is open for 2260 miles from the mouth of the St Lawrence to Port Arthur Thence to the Pacific railway communication covers an almost equal mileage In the winter months the whole distance must be traversed by railway The paid up capital on 15,768 miles of completed railway is \$887,975,020, or £11,263 per mile The confederation of Canada was accomplished in 1867 The construction of the Canadian Pacific Railway was commenced in 1877 The Dominion adopted in 1882 a policy of assisting companies by grants of money and lands under rigid restrictions in regard to quality of work In the East, cash subsidies per mile of \$1600, \$3200 or even \$6400 were granted under the Railway Subsidy Acts In the West, the subsidies took the form of land grants, and used rails were also given In 1886 the Canadian Pacific Railway was completed Up to the end of June 1894 the Dominion Government had assisted the construction of other than its own lines to the extent of £2,250,000, the Provincial Governments had contributed nearly £6,000 000 and municipalities nearly £3 200,000 The railways referred to on page 109 as examples of cheap construction on a narrow gauge have long since been incorporated in the Grand Trunk Railway and the whole of the Canadian railway system is now laid on the 4 feet 8½ inch gauge

SUPPLEMENTARY NOTE ON THE PROMOTION AND WORKING OF LIGHT RAILWAYS.

(Sectional Discussions and Conclusions relating to Light Railways reported in the *International Railway Congress Bulletin*, vol ii 1897)

Contributive Traffic (M de Backer's paper) —Feeder lines serve local, public and national interests so largely that they should be assisted, if necessary, by corporate bodies This assistance should, preferably, take the form of subscriptions for ordinary shares The great companies should not supply capital to the feeder lines, but should pay them a bonus per passenger or per ton Through booking of goods is not advised, not only because the expense of through service falls mainly on the small line, but also because the latter is forced to adopt the rates, classification, regulations, and system of accounts which obtain on the big line The small line requires little or no classification, and should be able to apply its own rates (pp 822–837)

Relaxation of Normal Requirements for Light Railways —Governments are generally recommended to facilitate the construction and working of light railways, which, however, must not be allowed to compete unfairly with existing lines Similar facilities should be granted to lines of light traffic which form part of main line systems (pp 840–880)

Working of Light Railways by Leasing Companies —As a rule, the lessee should provide the rolling-stock and the terms upon which the rolling stock is to be taken over on the expiry of the lease require very careful consideration There would be less objection to a subsidy based on the repayment of actual expenses, if the lessee [illegible] by increasing the net receipts, as, *e g*, if he were awarded [illegible] of working The [illegible] recommended It [illegible] percentage of the [illegible] ddition, whether or gross [illegible] not the same coefficient [illegible] as to goods receipts,

and whether or not there be a special remuneration based on passenger mile

Light Rail

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conditions of each case (pp 1186–1197)

Brakes for Light Railways.—Here, again, it must be recognised that the conditions are too variable to allow of definite conditions being formulated as to the special brakes to be used on light railways It is obvious, however, that economy must be the first consideration (pp 1200–1221).

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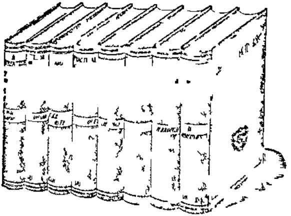

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PREFACE.

publication of the last two Editions of the "OUTLINES OF JURISPRUDENCE FOR INDIAN CRIMINAL COURTS," the Authors ken advantage of the many valuable criticisms that have d in the columns of the various public prints, both in Europe India, and likewise of the personal observations and sug- ns that have emanated from their legal and medical friends result, the text has been revised, the technical details annotated the purpose of rendering the subject thoroughly intelligible the lay reader, whilst the matter has been enlarged to extend s sphere of usefulness With these objects in view the book s now produced under the more comprehensive title of 'OUTLINES OF MEDICAL JURISPRUDENCE FOR INDIA,' and it has been divided into five Sections, namely,—

I —Method of investigating Medico Legal cases in India

II —Deaths from Violence—Suicidal and Homicidal

III —Offences against Chastity, Infanticide and Fœticide

IV —Life Assurance and Insanity

V —Poisons

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It has been our intention to adapt the book to the requi
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but likewise to Police Officers, Subordinates of the Judicial Servi
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as is contained in the more comprehensive and technical works on Indian Medical Jurisprudence, such as those of CHEVERS and LYONS—free from all that might otherwise be complex

We have to express our thanks to the many authorities of whose Works and Reports we have freely availed ourselves We desire specially to acknowledge the help we have received from CHEVER's *Medical Jurisprudence in India*, TAYLOR's *Principles and Practice of Medical Jurisprudence*, LYON's *Medical Jurisprudence for India*, MACKENZIE's *Medico Legal Experiences in Calcutta*, HUSBAND's *Forensic Medicine and Medical Police*, TIDY's *Legal Medicine*, GUY AND FERRIER's *Forensic Medicine*, BLYTH's *Poisons*, STEWART's *Trials for Murder by Poison*, SIR JOSEPH FAYRER's *Thanatophidia of India*, VINCENT RICHARD's *Landmarks of Snake-Poison Literature*, WALL's *Poisonous Snakes of India*, and from several contributors to the various volumes of the *Indian Annals of Medical Science*, especially HARVEY, KENNETH McLEOD, R F HUTCHINSON, COLLEN, and others All special abstracts, quotations, and remarks have, we think, been acknowledged in the body of the book Should we have unwittingly withheld the name of any writer of whose work we have made use, we would here express our regret for such omission So much, however, in Medical Jurisprudence and its allied subjects has become common property, that it is of difficult, if not impossible, to assign to the rightful Author his in particular references

We take the opportunity of stating that by Resolut[illegible] dated 9th June, 1890, this book has been adopted by [illegible] ment of Madras as the text book on Medical [illegible] also by His Highness the Nizam's Government for Police Officers, Pleaders and others, an[illegible] the fact that, perhaps, a lar[illegible] er of re[illegible] classes are more thoro[illegible] an Urdu translation [illegible]

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CHAPTER I.

INTRODUCTION

Preliminary remarks—Scope and object of this book—Necessity of some knowledge of medical jurisprudence—Necessity for careful observation—Marks found on dead bodies—Medical reports, what they should contain—Only facts should be recorded without any expression of opinion on the facts—Caution to be exercised before expressing an opinion—Evidence in regard to scars—Examination of external wounds—Wounds caused before or after death—*Post-mortem* examination of decomposed body—Whether body warm or cold when found—Points to be noted when a body is found—The inquest—Police notes

MEDICAL JURISPRUDENCE, LEGAL OR FORENSIC MEDICINE, is that branch of medical science which treats of the various connections between Law and Medicine. It deals with all medico legal subjects related to the administration of justice, and also with certain cases involving questions of the civil and social duties of individuals. Briefly, then, medical jurisprudence is the application of the science of medicine in all its branches to legal purposes. Some authors claim for medical jurisprudence a very wide field, but it is not the object of this book to discuss more than the outlines of the subject, a knowledge of which is required for the criminal cases which come before the Indian courts. Preliminary remarks.

of law Nor is it supposed that the scientific witness w' gain any more help from a perusal of this book than he possesses from his own knowledge There is, however, very large class of men in this country, who, though the daily avocations bring them into contact with the criminal courts, have little or no knowledge of medical jurispru' Police vakeels and magistrates are apt to consider that knowledge of medical jurisprudence can only be red with a knowledge of medicine, and the consequence is, that there are many trials which are carried through their various stages without the slightest enquiry into medico-legal* points which are of the utmost importance, and an elementary knowledge of which might possibly save many innocent man from punishment, or obtain the conviction o the guilty It is for such a class of persons that this bc is intended, and it does not profess to give more than the outlines of the science, with such practical hints, obta from many years experience, as may prove of service the conduct of criminal cases It simply opens a door, through which the student may see the many vast halls through which he has to go before he can pretend to be a real master of the science.

Scope and object of this book

Necessity of some knowledge of medical jurisprudence

2 Dr Taylor, one of the most eminent of medical jurisprudents, stated "Medico-legal knowledge does not consist so much in the acquisition of facts, as in the power of arranging them, and in applying to the purposes of the law the conclusions to which they lead A man may be a most skilful surgeon, or a most experienced physician, his mind may be well stored with professional information, yet, if he is unable by the use of simple language to make his ideas known to others, his knowledge will be of no avail One far below him in professional standing and experience may make a better medical witness" In the same way, it may be said that any man with ordinary common sense, and the talent of arranging facts, may, after mastering the rudiments of medical jurisprudence, be able

* Pertaining to law, as affected by medical facts —*Dunglison*

to prosecute or defend a case with success Writers on medical jurisprudence are almost exclusively medical men, their readers are chiefly medical men or medical students, and the information is given with a view to the witness box, where the medical man plays so important a part Of course, without a scientific training in medicine, the student cannot expect that his opinion will be called for as an expert, but a witness, however great his knowledge may be, can only give his evidence in answer to questions put to him It follows, therefore, that in order to be able to examine or cross examine a witness properly, the vakeel or lawyer must have a knowledge of the questions to be asked, and it will depend upon the questions that he puts, whether he will be successful in eliciting from the witness all the facts that bear upon the case The examination of a medical witness in this country is only too often of a most perfunctory character, and there is frequently no cross examination at all (In the majority of cases before the magistrates, the prisoner is never defended, and, unless he is a well to do man, he is generally undefended even in the higher courts) This is a matter much to be regretted, and there is a great deal in what has often been urged in the Public press, that public defenders should be appointed as well as public prosecutors As regards the police and the *subordinate magistrates, if they possessed a better know*ledge of the elements of medical jurisprudence, they would be able better to understand the points to be worked out, and would take more pains than they do at present to record even the minutest details Medical men are by no means infallible, though they are often inclined to be dogmatic, or, as Taylor says, "they are apt to confound what is mere matter of belief with proof" During late years the science of medical jurisprudence has made great strides In the majority of cases certain facts have become established, and in other cases it has been shown that *

* *Symptoms* are those phases or changes a d sease and wh ch serve to ind cate t[illegible] Symptoms are of two k nds—*subject* ve or those pat ent, a d *object* ve or those observed by the

time considered certain tests, are no longer so It should no longer be possible for a medical witness to dogmatise unless he can show his reasons for so doing If he cannot do that, and has merely his own opinion to set against the received authorities, his evidence is of little value

Necessity for careful observation

3 It has been remarked by a learned Scotch Judge in a trial for murder, where the prisoner was acquitted mainly owing to carelessness of observation when the body was first seen, that "*a medical man, when he sees a dead body, should notice everything*" In this country it rarely happens that a medical man sees a body when it is first found It is generally sent to him for examination many hours after death has occurred In nine cases out of ten the preliminary examination is conducted by the police and the village authorities Upon them, therefore, devolves that first and most important duty of observation It is, however, melancholy to find how grievously this duty is in most cases neglected The inquest paper, or *maha arnamah*, prepared by the police and village authorities is generally most unsatisfactory, and it almost always happens that evidence is elicited at the trial regarding the state and position of the body and its surroundings which have found no mention in the inquest paper This carelessness opens the door to concocted evidence on one side or the other, and it must be remembered that subsequent evidence of facts, not mentioned in the first report, is always open to suspicion To take one point which is alluded to further on in the text We can recall to mind but few cases of murder in which the witnesses who were present at the finding of the body have been able to say whether it was cold or warm Even in England, this is a point which Taylor says is frequently omitted to be observed, and, as he justly remarks, this omission "may give rise to great inconvenience, if not to a failure of justice" To those persons whose duty it is to collect the evidence for the prosecution, it may be said that every omission in the matter of observation is a point which the prisoner can advance in his favour Whether he will do so or not is another matter If he is an ignorant man, and is undefended, omis-

sions will probably not be noticed, but if we have a clever vakeel or lawyer to cross examine us, one who knows something of medical jurisprudence, we may feel sure that his questions will turn, not so much upon what we have observed, but upon what we have neglected to notice Each omission will then become a weapon of defence

4. It frequently happens that a medical witness says that, on examination of a dead body, he has found marks of blows, but it very rarely occurs to the prisoner's vakeel to ask the witness whether he has applied the only reliable test for distinguishing between *false ecchymosis* (or *hypostasis*)* and *true ecchymosis, viz*, incision It is probable that many sub magistrates and vakeels are not aware that there are certain *post-mortem* appearances which exactly simulate marks caused by blows, and if the medical witness has not applied the test, his opinion regarding the cause of these marks is worthless Mr Gribble has had a medical witness before him who, on being questioned, did not even know what hypostasis meant **Marks foun[d on] dead bodies**

5 Medical officers who conduct an examination, or a *post mortem*, should endeavour, as much as possible, to avoid technical terms in their report The report is not intended to give them an opportunity of displaying their learning, but of conveying information to others, which is best done by the use of ordinary and intelligible phraseology Let us take the case of an apothecary who is sent fresh from college to take charge of a mofussil station and dispensary, if, in his report of an examination of a dead body, he were to say (what has been said in a case quoted by Taylor),—"The only morbid appearance **Medical repo[rts] what they should conta[in]**

of the brain was an atheromatous deposit* in the Pons Varolii,† near the situation of the *locus niger*,"‡ it is ten chances to one that the sub magistrate to whom this report comes will not be any wiser than before

Taylor gives another amusing instance of this A medical man in court was describing the injuries he had found on the prosecutor He said that he had found him suffering from "a severe contusion§ of the integuments‖ under the left orbit, with great extravasation of blood and ecchymosis in the surrounding cellular tissue, which was in a tumified¶ state"

Judge —'You mean, I suppose, that the man had a bad black eye?'

Witness —'Yes'

Judge —'Then why not say so at once?'

Knowledge, which is locked up, as it were, in technical terms, is of no use except to the possessor of the key It may be very useful to the owner of the key, but, like a miser's wealth, it is of no good to any one else If we wish our knowledge to be of any use to others, we must make ourselves understood

Only facts should be recorded without any expression of opinion on the facts

6 Avoid, as far as possible, the expression of any opinion Record facts, and wait until your opinion on those facts may be asked for Mr Gribble remembers a case of considerable importance—it is discussed in detail hereafter as the Suriyana Kovil Case—in which a body was found

* –

† *Pons Varolii* is the term given to the lowest part of the brain except the medulla oblongata which is the link of communication between the spinal cord and the brain

‡ The *locus niger* or black spot is a part of the *Pons Varolii*

§ A bruise an injury without breach of the skin

‖ Skin

¶ Swollen

hanging The apothecary who first examined the body gave it as his opinion that death had been caused by hanging, and that owing to the absence of any marks of violence, the hanging had been suicidal It is clear that the latter part of this opinion was premature All that was wanted was an opinion as to the cause of death Whether it was a case of suicide or of homicide was for the magistrate and the judge to decide, and could depend only on the evidence

In another case, an apothecary swore that he believed the prisoner had caused an abortion by inserting a stick into the woman's private parts There was no doubt about the woman having been delivered, the only question was whether it was an abortion self caused or an ordinary miscarriage The apothecary had examined the woman three days after the delivery There was then no *lochial* discharge,* and all the symptoms that he could describe consisted in a slight redness of the parts It transpired that when the woman was brought for examination, the apothecary was told that she was suspected of having caused abortion In conducting an examination, the medical man should not allow himself to be prejudiced by statements of the case from the police or the parties interested He should state what he finds, and found his opinion simply upon those facts and nothing else, and the result will be far more satisfactory to the court before which the evidence has to be recorded Dr Casper, the eminent German medical jurisprudent, was a striking example of the value of medical evidence founded on a thorough independent examination He was most cautious in forming an opinion, but when he did so, it carried double weight Two of his reports are given as an example of what a report should be in the chapter on "Strangulation "†

* The lochial discharge or *lochia* is the sero sanguineous discharge that takes place from the genital organs during the two to four weeks succeeding labour

Caution to be exercised before expressing an opinion.

7. In this country especially, a medical witness should be most cautious in giving his opinion as to the cause of death It often occurs that the ostensible cause of death is not the actual cause For instance, it does not follow that in the case of a body found hanging, the cause of death *was* hanging The body may have been hung up after death, but death may have been first caused by injuries, or possibly, by poison Instances have occurred in which poison has been found in the stomachs of bodies found hanging Dr Chevers alludes to the frequency of the practice in this country of hanging up the bodies of persons who have been otherwise murdered This is a subject which will be discussed in more detail in the chapter on *Hanging*, and is only alluded to here in order to point out the necessity of a thorough *post-mortem* examination in all cases, even when there is seemingly an ostensible cause of death

In giving evidence as a witness, the medical man should—

(*a*) speak loudly and distinctly,
(*b*) answer questions categorically—"Yes" or "No",
(*c*) never use superlatives,
(*d*) give answers irrespective of the possible results of trial,
(*e*) express no opinion as to the guilt of the prisoner, but state facts only,
(*f*) avoid using technical terms, and
(*g*) avoid long discussions, especially theoretical arguments *

Evidence in regard to scars

8 Questions may arise in the evidence of a medical witness in regard to the age of scars and to the possibility of scars and tattoo marks disappearing Regarding scars, Casper said "Scars occasioned by actual loss of substance, or by a wound healed by granulation, never disappear, and are always to be seen upon the body, but the scars of leech bites, or of lancet wounds, or of cupping instruments, may disappear after a lapse of time that cannot be more

* HUSBAND s *Forensic Medicine and Medical Police* Fifth Ed p 17

distinctly specified, and may therefore cease to be visible upon the body It is extremely difficult, if not impossible, to give any certain or positive opinion as to the age of a scar" A change of atmospheric temperature may cause the reappearance of scars that have apparently vanished Slapping the part may likewise do so Scars in children grow in length only The manner of production of the wound and the nature of the healing process affects the shape of the scar Clean cut or incised wounds leave linear scars, but a wound healing by granulation will probably be irregular in shape Scars of gun-shot wounds will be irregular and disc shaped, and adherent to the sub lying tissue With regard to tattoo marks, they "may become perfectly effaced during life," especially is this so if vermilion has been used, they are much less likely to disappear if Indian ink is deposited in the skin It may be remembered that the question of the disappearance of tattoo marks created much discussion in the celebrated Tichbourne case

9 Examine most carefully the size and position of all external wounds The case of *Reg* v *Gardner* is one of the leading cases on this point Here a woman was found dead, her throat cut, and a razor in her right hand The wound in the throat, however, was in such a direction that it could not possibly have been caused by the right hand, and there were cuts on both hands which could only have been caused in a struggle, proving beyond a doubt that a murder, and not a suicide, had been committed Examination of external wounds

10 Be careful in noting any signs which may go to show whether the wounds were caused before or after death An interesting case, showing the importance of this point, was tried at the Cuddapah Sessions in 1873 The body of a man was found in a well, and certain persons were accused of having thrown him in There were no external marks of injury except that one of the ears was missing At the trial, it was urged for the defence, that the deceased had accidentally fallen into the well, and the ear had been Wounds caused before or after death

eaten off by fishes, crabs, &c Although the body had been examined by a medical man directly it was found, there was no reliable evidence to show whether the ear had been cut off before or after death If it had been cut off before immersion, it is probable that there would have been some contraction of the edges of the wound or some other signs of a natural tendency to heal, which would not be the case if the ear had been bitten off by fishes after death The accused were acquitted, and the death was held to have been caused by accident

Post mortem examination of decomposed body

11 The Surgeon should not be deterred from a *post-mortem* examination on account of the decomposed state of the body Of course, there are cases in which decomposition is so advanced that an examination is impossible, but there is good reason to believe that cases occur where decomposition is given as a reason for not holding an examination, when one might really have been held Dr Casper once examined the body of a woman who had died ten months previously by falling into a cess pool Not only was the body highly decomposed, but a portion had been converted into adipocere * The woman s master was suspected of having seduced the deceased and of having thrown her into the cess pool, fearing that she would give birth to a child and the result of the intimacy become known Casper, knowing that the womb resists the action of decomposition longer than any other part of the body, persisted in his examination, and found that the womb contained no fœtus, and that, therefore a great part of the suspicion was unfounded

Whether body warm or cold when found

12 Be most careful in enquiring whether, when the *body* was found, it was *warm or cold* † Allusion has already been made to the importance of this point, but the case of

* [illegible]
m
m
w
c urtl s.

† The rap dity with wh ch the temperature of the body falls after death

Gardner, already mentioned, may be given as an instance In that case two persons were accused of the murder, and the innocence or guilt of one depended entirely upon the time it takes for a body to cool The body when found was rigid, and if rigidity could have set in within the space of four hours, the murder must have been committed by the second prisoner, a woman named Humbler, who, for four hours previous to the finding of the body (about 7-30 A M), was the only person in the house If it takes four hours and more for rigidity to set in, which is the time fixed by the most experienced physicians in Europe, the murder must have been committed by Gardner, who, up to that time, was in the house and in the same room with the deceased Other circumstances tended to fix the guilt upon Gardner, and he was convicted, the woman Humbler being acquitted, but had the body been warm at the time it was found, there can be no doubt that Gardner would have been acquitted and Humbler probably convicted

13 In this country, where there are so large a number of deaths reported as from drowning, it would seem advisable that every case of suspicious death should be sent to the nearest hospital for *post mortem* examination On receiving notice of a suspicious death, the village authorities should at once send information to the nearest police station, Points to be noted when a body is found

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varies under different circumstances as the following table from HUSBAND s *Forensic Medicine* shows —

COOLING OF THE BODY

a External circumstances	Covered by bed clothes or otherwise unexposed, when cooling will be slower than in cold dry air quickly moving
b Condition of body itself	Slow, if fat
c Kind of death	*a* Wasting diseases—Quick *b* Suffocation—Slow *c* Cholera yellow fever, rheumatic fever and cerebro spinal meningitis—Increase of heat after death

F fuller remarks on this point see Part II Chap I [illegible]

and the enquiry should commence. The following are some of the points about which the fullest information is necessary and should be available —

(1) Date, place of making the examination, and names of those who can speak to the identity* of the body?

(2) When the body was first found, was it warm or cold? Was it rigid or not? Was it well or ill nourished?

(3) Had decomposition set in; if so, how far had it advanced?

(4) What was the exact time of death?

(5) When, where, and with whom was the deceased last seen alive?

(6) What was the exact attitude and position of the body when found?

(7) Note the position of all surrounding articles, such as bottles, papers, weapons or spilled liquids

[Note —These articles should be collected and preserved]

(8) Note the exact position and size of any marks of blood on the body or in the vicinity State whether the blood was dry or liquid Condition of clothes of deceased—torn or disordered.

(9) Did the deceased show any special symptoms? If so, when were they first noticed, and how long did they continue? What were his habits?

(10) How long after partaking of any meal, food, drink, or medicine, did the symptoms occur?

(11) Did they intermit, or did they continue without mitigation until death?

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* With regard to identity in the *living* it should be remembered that the hair is often dyed blue black or reddish by the people of India, either for

(12) Secure any portion of the food or medicine which may be suspected to contain poison

(13) Secure all matter vomited or evacuated

[*Note*—When securing food or vomited matter, be most careful to put each matter separately in a *clean* pot or vessel, do not take any old pot, or piece of pot, that may be offered, but insist upon being supplied with a new and clean earthen vessel, which should at once be securely fastened, and, if possible, sealed and carefully guarded, until it is given into the hands of the medical officer]

(14) Note the external appearance and general colour of the body, and all marks of violence, scars, the products of disease such as ulcers, hernia, &c.

(15) Are there any injuries?

[*Note*—We should recollect that there may be no external signs of injury and yet death may be due to violence There is often great difficulty in deciding whether an injury was inflicted before or after death]

(16) Note the height, determined by measurement, and apparent age

(17) Note the sex.

[*Note*—It is only in advanced putrefaction that this is difficult to determine Hair found only on the pubes is characteristic of the female, but if it extends upwards on the abdomen it is equally so of the male]

(18) Note the position of the tongue, is it normal or abnormal, injured or not?

(19) The condition and number of the teeth, are they complete or incomplete? Any peculiarity as regards size and form, in order to compare with bite on suspected party, &c

(20) Condition and contents of the hands and nails (In the drowned, weeds, sand, and indications of prolonged immersion In those *shot*, scorching and blackening of the hand from powder, or injury from recoil of the weapon) Is the weapon grasped firmly in the hand Cadaveric spasm?

(21) Condition of the natural openings in the body—nose, mouth, vagina, &c Presence of sand or weeds in the mouth of those found in the water. Presence of marks of the corrosive poisons Presence or absence of signs of virginity, or of recent injury about the female external generative organs

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(22) Condition of the neck Presence of marks of strangulation Any irregularity in the line of the vertebræ Are there any marks upon the throat or under the ears

Note any other suspicious circumstance and all statements of suspected parties, ascertaining the business of the deceased (if any) and whether he has experienced any disappointment or misfortune, or whether there is an insurance on his life

Finally, after having noted these points, and after having caused them to be entered in the *mahazarnamah* or inquest paper, which should be signed by the village authorities, have the body at once taken to the nearest hospital or dispensary Accompany it there, and take with you all matters and articles connected with the case Be careful that no unnecessary delay occurs in this respect, for it is of importance that the body should, if possible, arrive at the hospital before decomposition sets in

The inquest

14 It very often happens that the inquest held by the village authorities is nothing more than a farce Owing to their dread of pollution from being brought into contact with a dead body, the members of the inquest often sit down at a distance and afterwards sign the record upon hearsay *The police officer should insist upon the members of the inquest personally satisfying themselves as to the correctness of the statements in the inquest paper* This paper should contain full and detailed information on the several points just mentioned If information is omitted from the inquest paper and subsequently supplied, it is always open to suspicion

Police notes

15 The police officer should also remember the necessity of taking full notes for his own information When called upon to give evidence, he should not attempt to speak merely from memory, but, if he has taken notes, he should ask to be allowed to refer to them Considerably more weight will be attached to his evidence if it is shown that he exercised an intelligent observation, and if he shows

himself cautious before committing himself to a statement of opinion If he has omitted to note any special point, it is far better, should he be asked a question, to at once admit the omission, instead of making a guess, which may very possibly be proved to be wrong.

Surgeon-Major Cullen favoured Mr. Gribble with the following remarks —

"I have had corpses sent me from a distance, the escort "of which having been changed, I could get no information "as to whose corpse it was supposed to be, the Police report "reaching me, perhaps, some hours after or next day; and "I have been obliged to say I examined a body at such an "hour, and said to be brought from such a direction, but "could not say if it was that of deceased.

"A medical man should put private marks on each article "he examines I have had a case in which I examined "several clothes for blood stains and numbered them, but "in Court I found all my numbers had been changed from "one to the other"

CHAPTER II.

ON EVIDENCE IN INDIA.

False [illegible]

THE great difficulty with which all magisterial and judicial officers in India have to contend, is the false evidence which daily comes before them

16. It is probably no exaggeration to say that a case scarcely ever comes before a criminal court in which there is not a certain amount of false or concocted evidence. Even in cases which are substantially true, there is generally a False and concocted evidence.

certain amount of concocted evidence This evidence breaks down and is proved to be false, and the result very often is that a true case gets let off The duty of a judge or a magistrate in this country is, generally speaking, not so much to decide which story is the true one and which the false one, but to separate the falsehood and the truth on both sides, and, having eliminated the former, to decide upon the case Mr Holloway, for many years a distinguished judge of the Madras High Court, frequently remarked in his judgments, that the legal maxim, *falsum in uno, falsum in omnibus*,* did not apply to this country In England, the discovery that some of the evidence for the prosecution had clearly been concocted, would probably be quite sufficient to ensure the release of the accused, but if such a rule were to be followed in this country, there would scarcely ever be a conviction

Instances of peculiarities of native evidence

17. The native mind is, generally speaking, unable to understand that the truth "unadorned is adorned the most," and a witness, therefore, adds on to what he knows, not so much with the intention of speaking a falsehood, but in order to make the case as safe as possible Instead of confining himself to what he knows or has seen, he speaks of what he has heard, or what he thinks took place An amusing instance of this moral perversity is given by Chevers —

A man named Luxiah bin Budiah was tried for perjury at Khandesh (1837) At a trial for highway robbery, this person had given evidence under the name of Kalliah-bin-Dowjee, and had sworn that, on a certain date, he had followed up the footprints of certain robbers, etc On being cross-examined respecting various particulars which he had not come prepared to answer, he admitted that his name was not Kalliah bin Dowjee but Luxiah-bin-Budiah, and further that he was not present when the robbers were traced He further said that his friend, the *real* Kalliah, was sick and unable to attend the court, and that therefore he came to

* 'False in one thing false in all '

depose for him, that the facts to which he had deposed were perfectly true, and that although he was not himself an eye witness, yet they were notorious to all the people of the village He was sentenced to one year's imprisonment with labour and to receive twenty-five stripes

Mahomedan law in regard to evi dence by proxy

18 On reference to Goodeve, we read that "Mahomedan law, in certain prescribed cases, allowed the singular expedient of giving evidence *by proxy* In the event of the death of the principal witness, the absence of the witness on a three days' journey, or his sickness, and in a certain class of cases where the judgment was not barred by doubt, a witness, or the person who would have been such, was permitted to supply a proxy, substituting another person to detail facts or opinions for him"

False evidence in a true case

19. The following case occurred within Mr Gribble's experience, and shows how false evidence can be brought into a true case A merchant was passing through a village with a number of bandies laden with timber A number of Madigas danced the 'sword dance' in front of the bandies This is a dance which, when performed, always excites the indignation of the Malas (These two classes of men form the representatives of the left and right hand castes amongst the Pariahs) The Malas protested against the dance, a fight followed, and a Mala was so severely wounded that he subsequently died of his injuries An attempt was made to prove that the merchant had struck the blow of which the Mala died, but when the witnesses came to be cross examined regarding the details of the fight and what subsequently happened, they broke down entirely There were minor discrepancies regarding the actual spot where the blow was struck, but three of the witnesses were palpably inconsistent One said that the deceased, after he had been struck, was carried to the choultry, where he lay insensible for the whole of the night, until the police came next morning, a second said that the deceased, after he was struck, was left on the road, where he remained groaning and insensible the whole night, and the third, a police constable, said that

deceased, immediately after he had been struck, walked about two miles to the next police station, showed his wounds, and laid a complaint against the prisoner! This witness, in describing the injuries, had taken no notice, or no complaint was made, of the injury which subsequently caused death, namely, a blow on the skull which caused a piece of the bone to impinge on the brain Another strange incident in this case was that the deceased was sent to the hospital and discharged cured after about five days, the injury to the brain having been unnoticed A few days afterwards he was again admitted, and died of the injury, which had been previously unremarked

In this case there could be no doubt that there was a fight between the Madigas and the Malas, when the latter obstructed the procession, but after a man had been seriously wounded, it was attempted to put the responsibility on the merchant, who, during the fight, was lying ill in his bandy

False evidence through fear

20 False evidence is as often given or concocted through fear as through enmity or evil motives The following case tried at the July sessions (1884) at Cuddapah, is a good example —

Two brothers lived together, they were well to do, and their house had been twice robbed A noted robber, who had several times been convicted, and who was the terror of the neighbourhood, lived in the next village On a certain occasion one of the brothers went away for two days on business, while the other brother remained at home During the night he heard some one breaking into the hut where their goods were kept He went to the door and saw the robber they so much dreaded, leaning down, trying to open the lock of an inner compartment He rushed in with a stick and struck the man a blow on the head The robber stooped down to pick up a stick by his side, and the man gave him another blow At this juncture a neighbour came in and, struck him a third blow It was then found that the robber was dead Becoming frightened, the men put

the corpse in a bandy and drove off two miles to the railway, where they placed the body on the line just before the mail train passed The body was found next morning with the head cut off and the legs broken The train had passed over the neck and the legs The remains were sent to the hospital and the skull was found to be fractured in two places, evidently by blows, and the spleen and liver completely ruptured From the spot where the body was found, up to the prisoner's house, were discovered marks of wheels and a track of blood Both brothers were accused of murder One pleaded an *alibi*, which was true, and the other denied all knowledge of the robbery or of the death of deceased It had been a moonlight night, and almost all the neighbours had turned out at the noise, yet some were found to swear that the brother, who at the time was several miles off, was one of the persons who put the corpse in the bandy After the prosecution had closed, and before the summing up, the second prisoner, wisely persuaded by his counsel, made a clean breast of it, told how the robbery took place, and that, dreading the known strength and violence of the robber, he had struck him several times, and then fearing the consequences, had driven the body off, helped by a neighbour, to the railway The second prisoner was acquitted on the ground that he had acted in justifiable defence of property The first prisoner, who had been absent, was also acquitted If the prisoners had only told everything at first, they would probably have never been committed

21. Another reason for false evidence is ignorance A witness comes up on behalf of the accused or, it may be, of the prosecutor He is first examined by the vakeel for his own side He knows that this vakeel will ask him no embarrassing questions, and answers everything without hesitation In fact, he probably says a great deal more than he really knows When the other vakeel gets up, he knows that he is retained on the opposite side, and his questions may therefore be dangerous Accordingly, he thinks the best thing to do is to answer every question in

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the negative, and is not deterred even when the answer is palpably an untruth He soon gets into difficulties and then has to admit that he has been giving false answers. This, of course, throws suspicion upon the whole of his previous evidence, the principal part of which may have been true

Remarks on the evidence of the uneducated class of natives

22 The idea of a witness of the uneducated class of inhabitants, seems to be that he must help the judge to convict or acquit the prisoner, as the case may be "This or that is what really happened," he thinks, "but if I don't tell the judge he will never find it out" Of course, there are a great many cases in which the evidence is wilfully false, but we believe that in a very large number of cases, where false evidence is given, it is not intentional, and it only requires a little patience and good humour to find out what is true and what is false In civil cases this is much more difficult, and there is scarcely a civil case that comes before the courts in which there is not wilful perjury and frequently forgery on both sides These cases generally have to be decided on hard facts and on circumstantial evidence Good circumstantial evidence is generally supposed to be the best kind of evidence that can be produced, but it is remarkable in this country how frequently circumstances are forged so as to fit in with one another

False confessions are not uncommon

23 False confessions are also not uncommon In Europe it sometimes happens that a man will make a false confession of a crime that is occupying public attention, but it is generally found that the person is of weak intellect In this country, however, confessions are sometimes made simply because the accused know there is strong suspicion against them, and think that, possibly by confessing, they *may get off the extreme penalty* Dr Chevers mentions several cases of persons who confessed to having murdered men who were still living, and who had never been attacked This is often ascribed to undue pressure of the police, and there can be no doubt that fear of torture has produced many a false confession It would be a bold thing to say

that police torture no longer takes place, and Mr Gribble has frequently had cases before him where confessions had been made which were subsequently withdrawn, and which he could account for in no other way than that undue pressure had been used by some one The subject of police torture is alluded to further on, and we will not therefore dwell upon it here It may, however, be as well to allude to the remarkable success which attends the efforts of some of the special dacoity inspectors One of these officials never brought a case into court without a confession from one or other of the prisoners There is every reason to believe that the cases brought up were true cases, though whether all the details of the confessions were true is another matter There can be no doubt that a large number of these confessions were obtained, not by torture but by persuasion A prisoner is told that if he will make a clean breast of the matter, he will probably get a comparatively slight punishment, and in the meantime his family shall be provided for The villagers themselves are only too glad to get a dangerous gang run in, and make arrangements for the provision of the family of the man who confesses The confession once made, leads to other evidence corroborating it, and the gang is broken up It is, of course, a fact that there are a number of entirely false accusations, but we believe it to be equally a fact that the persons sent up for trial are, generally speaking, the real offenders, though it probably very often occurs that the evidence submitted in support of the accusation is entirely false

24 Zeal in detection sometimes carries the police a great deal too far, and Chevers quotes a case in which the police, having found an unrecognizable dead body, manufactured a murderer [illegible] concubine wa[illegible] murdered him, and identified the corpse as that of the missing man The man himself however turned up just at the right moment, and the prisoners were acquitted Sub- Zeal of police sometimes carried too far

sequently, three of the police were convicted of having extorted confessions and sentenced to five years' rigorous imprisonment

Concluding remarks

25 The foregoing remarks are nothing more than an allusion to this subject To treat it exhaustively would require a whole volume, but to those who wish to study the subject further, and to read some remarkable cases of false evidence, fabricated charges, and police torture, we would recommend a perusal of Dr Chevers' work, in which this subject (as, indeed, are all other subjects connected with Indian Medical Jurisprudence) is dealt with in the greatest detail, it is a mine of valuable information

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CHAPTER III

MODES OF DEATH

Syncope—Asphyxia—Coma—Tabular view of modes of death—Coma death beginning at the head—Syncope death beginning at the heart—Apnœa (asphyxia) death beginning at the lungs—Causes of sudden death—Presumption of death—Presumption of survivorship—Definite rules exist in some countries in regard to survivorship—English law presumes nothing—Exceptional rules in regard to survivorship

THERE are three modes in which death may take place—by Syncope, Asphyxia, and Coma

26 Syncope, or arrest of the heart's action, may occur from (a) deficiency of blood, due to hæmorrhage, and (b) the effects of certain diseases and poisons The *post mortem* signs of this mode of death are —The heart contains the natural amount of blood, there is blood in the veins and arteries, and there is neither engorgement of the brain or lungs

27 Asphyxia, or apnœa, death occurring as a result of any serious interference with the action of the lungs or the respiratory mechanism It may be caused by (a) certain diseases of the lungs, and (b) mechanical obstruction to respiration The *post mortem* examination shows distension of the pulmonary artery and its branches, of the right side of

the heart, and of the venæ cavæ,* the left side of the heart and the aorta are comparatively empty

28 In Coma, death is due to some cerebral or brain mischief, such as may be caused by apoplexy, fracture of the bones of the head, compression of the brain, etc *Post-mortem* we find congestion of the membranes and substance of the brain and lungs, with more or less blood in the right cavities of the heart Coma.

29 The following gives in tabular form the various modes of death — Tabular view of modes of death

I —COMA—DEATH BEGINNING AT THE HEAD *or, in the brain* — Coma—death beginning at the head.

Pressure on the brain or medulla oblongata (Compression, apoplexy, hydrocephalus† etc)

Blows on the head causing cerebral disturbance. (Concussion, shock, etc)

Action of narcotic poisons from their specific action on the brain and nervous system (Opium, etc)

Action of certain mineral poisons (Barium, arsenic, etc)

Certain discharges and hæmorrhages, which, although incapable of producing syncope, paralyse the nervous centres

Plugging of an artery supplying the brain by a clot, or by solid material detached from any surface over which the arterial current has flowed

Certain cases of kidney or liver disease (Uræmic poisoning, etc)

II —SYNCOPE—DEATH BEGINNING AT THE HEART — Syncope—death beginning at the heart

(1) *Anæmia—a deficiency in the quantity or alteration of the quality of the blood—*

Injuries to the heart or to the larger blood vessels

* The large veins which convey the blood from the body to the heart

† *Hydrocephalus* is the technical name for the disease popularly called "water on the brain" It is a collection of fluid in the cavities of the brain frequently the fluid surrounds the brain as well.

Hæmorrhages from lungs, uterus, etc (Death by depletion)

Discharges other than blood but which indirectly drain the blood (Extensive suppuration, etc)

(2) *Asthenia—a deficiency in the power of the heart or general vital forces—*

Starvation

Exhausting diseases (Phthisis, diabetes, dysentery, cancer—especially of the stomach and œsophagus, tumours pressing on the thoracic duct, etc)

Action of certain poisons

Certain injuries (Concussion of the spine Severe blows on the epigastrium, etc)

Severe brain lesions

Apnœa (asphyxia)—death beginning at the lungs

III —APNŒA (ASPHYXIA)—DEATH BEGINNING AT THE LUNGS —

(1) *Stoppage in the action of the respiratory muscles*

This may result from—

Exhaustion of the muscles (Debility, cold, etc)

Loss of nerve power. Injury to the upper part of the spinal cord or division of the pneumogastric* or phrenic† nerve, producing paralysis of the muscles of respiration

Mechanical pressure on the chest or abdomen.

Tonic spasm (Tetanus, hydrophobia, etc)

(2) *Stoppage in the action of the lungs themselves*

This may result from—

Mechanical obstacles (Entrance of air into chest, through wounds in the thorax, through wounds in the diaphragm, etc)

Division or compression of the eighth pair of nerves—that is, the pneumogastric

* A pair of large nerves which are mainly distributed to the lungs and stomach but also supply the larynx pharynx heart liver, etc This nerve is also called the *par vagum*

† The nerve which supplies the diaphragm or midriff

(3) *The entrance of pure air into, or the escape of impure air from, the lungs being prevented*

This may result from—

Foreign bodies in the mouth, nose, larynx, etc.

Submersion.

Suffocation, strangulation, hanging.

Want of air (as in very high altitudes) or want of a sufficient percentage of oxygen, although the diluent gases, such as nitrogen and oxygen, be inert

Certain irritant gases as SO_2, Cl, etc, which produce spasm of the glottis *

(4) *The supply of blood to the lungs prevented by the plugging of the pulmonary artery*† *by a blood clot (embolus)* ‡

30 Amongst the causes of sudden death (excluding violence and poison) we may mention§ — Causes of sudden death.

(1) Disease of the heart (especially fatty degeneration, angina pectoris,|| aortic regurgitation,¶) and diseases of the pericardium.**

(2) Diseases of the blood-vessels, especially aneurism and thrombosis †† (The forms of aneurism mostly likely to end suddenly are intra-cranial, intra-pericardial, abdominal and pulmonary). Injuries to arteries, such as occasionally occur

* The *glottis* is the opening at the top of the larynx

† The *pulmonary artery* is a large vessel which passes from the right side of the heart to the lungs after dividing into two large branches

‡ TIDY's *Legal Medicine*, p 282 *et seq* An *embolus* is a clot of blood brought by the blood current from a distant artery, and forming an obstruction at its place of lodgment

§ TIDY's *Legal Medicine*, Part I, pp 279, 280

|| *Angina pectoris* is sometimes called "neuralgia of the heart."

¶ *Aortic regurgitation* is a disease of the heart caused by the *backward* flow of blood from the aorta into the left ventricle during the diastole of the heart The *diastole* is the period of rest of the heart

** The *pericardium* is the fibro serous covering of the heart—the bag in which the heart is contained

†† *Thrombosis* is the process by which a thrombus is formed. A *thrombus* is a clot of blood formed at the place of the deposit of an obstruction in the blood vessel.

from angular curvature,* etc , have been known to cause sudden death

(3) Large effusions of blood in the brain or its membrane—cerebral and meningeal apoplexy

(4) Pulmonary apoplexy and hæmato thorax †

(5) The sudden bursting of visceral abscesses

(6) Ulcers of the stomach, duodenum,‡ or of other parts of the alimentary canal

(7) Extra uterine fœtation§, peri and retro uterine hæmatoceles ‖ apoplexy of the ovary,¶ rupture of the uterus

(8) Rupture of the urinary bladder or of the gall bladder, or of some other viscus from accidental violence or other cause

(9) Cholera and certain zymotic diseases** at times kill very rapidly

(10) Large draughts of cold water taken when heated (The sudden effects resulting from imbibing large quantities of spirit come under the head of 'alcoholic poisoning')

(11) Mental emotion

(12) The accidental swallowing of foreign bodies, so as to cause blocking of the pharynx and obstruction of the glottis

Presumption of death

31 With regard to the presumption of death Lyon answers the question, When will it be presumed that a person is dead? as follows — In India, the law is (*a*) that if

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* *Angular curvature* refers to a bending of the spinal column

† *Hæmato thorax* is the emptying of a wounded or ruptured vessel within the cavity of the chest

‡ The *duodenum* is that part of the small intestine just below the stomach

§ *Extra uterine* fœtation or ectopic gestation is the development of the ovum outside the normal cavity of the uterus

‖ *Peri-and retro uterine hæmatoceles* are tumours formed by the extravasation and collection of blood around and behind the womb

¶ The *ovary* is the organ for the deposit and evolution of the primordial ovule corresponding to the testicle of the male and situated one on each side of the womb

** The term *zymotic* is applied to diseases generally classed as epidemic endemic or contagious and now believed to be due to specific viruses

a person is proved to have been alive within thirty years, the legal presumption is that he is still alive, except (b) it is proved that the person has not been heard of for seven years by those who would naturally have heard of him if he had been alive, in which case the law presumes that he is dead (Sects 107 and 108, Indian Evidence Act). The law, however, presumes nothing as to the time of his death, the period of which, if material (as it often must be in cases of succession and inheritance), must be proved by evidence In either case, the presumption arising may be rebutted by proof, in case (a) of the person's death, in case (b) of his being still alive In France, a legal presumption of death arises after thirty-five years of absence, or after one hundred years from date of birth"

32 *With regard to the question of presumption of survivorship*, Lyon states that "when two or more persons die at almost the same time, or by a common accident, the question may arise who survived longest, and if no direct evidence on this point is available, the question becomes one of presumption of survivorship As an example of the cases in which this question arises —Suppose A to have left property by will to B, and that A and B die by a common accident, no direct evidence being available as to whether A or B died first Here the question of presumption of survivorship may arise, because if A died before B, B may be considered to have succeeded to the property left him by A, and B's heirs inherit, while if B died first, A's heirs inherit, seeing that B never succeeded to the property willed to him by A" *Presumption of survivorship*

33 In some countries definite rules of law exist by which such cases are decided In France, for example, some of the rules laid down are — *Definite rules exist in some countries in regard to survivorship*

(1) If all those who perished together were under fifteen, the oldest shall be presumed to be the survivor

(2) If all were over sixty the youngest shall be presumed the survivor

(3) If all were between fifteen and sixty, the males shall

be presumed to have been the survivors if the ages were equal, or the difference in age not greater than one year

(4) In other cases, the youngest shall be presumed to be the survivor

English law presumes nothing

34 The English law presumes nothing in cases of this kind, and if, therefore, a person made a claim and had, in order to substantiate it, to prove that A survived B, and had no proof of that fact beyond the assumptions arising from age or sex, he could not succeed

Exceptional rules in regard to survivorship

35 It may, however, be pointed out, that in questions of this kind, it is likely that the strongest lived longest There are, however, certain exceptions, for example —

"(1) Where a mother and child both die during delivery, if the death of the mother has been caused by hæmorrhage, it is probable that the mother died first

"(2) If a number of persons die from the effects of excessive heat, it is probable that the adults died first, children and old persons bearing heat better than adults

"(3) Where the cause of death is drowning, as females are more likely to faint than males, and as the occurrence of syncope delays death by asphyxia, it is possible that females may survive longer than males If, however, there has been a struggle for life, it is probable that the males, being stronger, survived the females

"(4) Where the cause of death is starvation, aged persons (if healthy and robust), requiring less food than adults and children, probably live longest"*

* LYON's *Medical Jurisprudence for India*, pp 27 and 28.

CHAPTER IV.

WOUNDS AND INJURIES.

What are wounds—Cause of death—The inquest—Identification of the body—General details to be observed in regard to identity—Special appearances to be noted in case of mutilated remains—Notes in regard to a skeleton or individual bones—Clothes or ornaments may aid in establishing identity—Remarkable cases of identification—Subsequent evidence regarding wounds—Evidence as to whether wounds caused before or after death—Wounds caused after death—Distinguishing features of wounds inflicted before and after death—Suspicion thrown on enemies of deceased's family in cases of natural death—Retracted vessels safest sign of wounds caused during life time—The *post-mortem* examination—Size and description of wounds to be noted—Has the wound been inflicted before or after death?—Bruises or contused wounds—Difference between a blow caused before and after death—Rule not to be taken as a hard and fast one—Certainty of the rule as regards a blow given after *rigor mortis* has set in—Appearance of wounds inflicted during life—Appearance of wounds inflicted after death—Case of judicial murder of innocent man—Position and course of wound to be described—Rules adopted in Europe regarding period of death not applicable to India—Death where there is no internal or external mark of injury—Death from shock—Death from squeezing of testicles—Death of wounded persons from natural causes mistaken for violence—Death after long periods—By what kind of weapon was the wound caused—Difficulties in regard to fractures greater than in the case of wounds—The rice pounder a common weapon of assault in the Madras Presidency—Presumption of intention from the weapon and violence used—The Bamboo or *lathi* commonly used in Bengal

MEDICAL evidence is required principally in cases where injuries have caused death In cases where the injured person recovers, his own evidence is available, though it may often occur that medical evidence is required in corroboration, or to prove that the wounds have, or have not, been self-inflicted We will, therefore, first consider cases in which death has occurred. These may be divided into two classes (1) death caused by wounds, or external injuries, and (2) death caused by hanging, drowning, suffocation, strangulation, throttling, smothering, and starvation.

What are wounds

36. Under the head *Wounds* fall all those injuries which come within the definition in the Penal Code of hurt and grievous hurt It depends upon the nature of the hurt caused, the intention of the party causing it, and the result of the hurt, whether the accused is guilty of simple hurt, grievous hurt, attempt to commit murder, or murder itself *

Cause of death

37. The cause of death is the first and most important question which arises, and is one about which a doubt arises oftener in this country than in Europe As already stated, it frequently happens that the apparent cause of death is not the actual cause of death It is, therefore, of the utmost importance that, as soon as the dead body is discovered, the surrounding circumstances should be most carefully noted When possible, a corpse should be left untouched in the position in which it has been found, until the arrival of the police, or, if they are too far distant, until it has been inspected by the village authorities

The inquest

38. The result of this inspection must be at once reduced to writing, and in this document—called in the Madras Presidency a *mahazarnamah* and in Bengal, *sooruthal*,—every circumstance should be carefully noted. In the mofussil, the village magistrate occupies the position of the coroner, and it very often depends upon the accuracy with which his report is drawn up, and the confidence which can be placed upon it, whether a crime results in detection or not

Identification of the body

39 The first point is the identification of the body In this country, where there are so many wild animals, it is often very difficult to identify human remains as being those of a supposed deceased person A case occurred in the June sessions at Cuddapah (1883), in which the body of a woman, who had been killed twenty-six hours previously and left in a *vanka* or dry river-bed, was found entirely stripped

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* The old surgical definition of a *wound* makes it consist in a *solution of continuity* This definition would not include contusions concussions, [illegible] the solution of

of flesh The body was, however, identified by a missing tooth in the jawbone and by some of the articles of clothing found lying near it This is, probably, one of the most rapid cases on record in which all traces of flesh have been removed Generally speaking, from three to four days elapse before all traces disappear, and even after this lapse of time, bodies are sometimes found almost intact Owing to the scanty clothing which natives wear, it is often exceedingly difficult to identify remains, and it is, therefore, of importance that nothing should be omitted which can bear upon the question of identification As a matter of fact, many cases have been convicted—and the convictions confirmed by the High Court—in which there has been no identification of the remains, but, as a general rule, in such a case, the sentence is generally not one of death, but of transportation for life This, however, is not invariably the rule, as will be seen by a reference to Illustrative Cases I and II

General details to be observed in regard to identity

40 The ensuing summary of the details to be generally observed and noted in the examination of persons, or of bodies, or of bones regarding identity may be interesting —

I —The following points should be noted under general circumstances —

(1) The surroundings of the body—
- (a) Clothes
- (b) Jewellery
- (c) All articles found on the body or in the coffin
- (d) Hairs grasped in the hand or free about the body.

(2) The probable business or trade at which the person worked—
- (a) Condition of the hands (horny or soft).
- (b) Any special injuries to nails
- (c) Any special stains (such as silver and dye stains)

(3) The height of the person
(4) The weight of the person.

(5) Age—
(a) The amount and colour of the hair.
(b) The teeth
(c) The condition of the alveolar processes.
(d) The condition of the fontanelles *
(e) The points of ossification †
(f) The condition of the epiphyses ‡
(g) The size of the bones

(6) Sex—
(a) The genital organs
(b) The breasts
(c) The general conformation
(d) The length of the back hair, and the nature of the hair generally
(e) Pelvis §
(f) The markings of the bones.

(7) Deformities —
(a) Shortening of legs from disease of hips, etc.
(b) Spinal disease.
(c) Talipes ||
(d) Large wens,¶ etc

(8) Marks, growths, etc, on the skin. Distinguish between those arising—
(a) From disease (such, e g, as scrofulous ulcers, small-pox, diseased teeth, syphilis, skin disease, etc)

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* The *fontanelles* are the membranous spaces in the infant's head, from delayed formation of bone in the cranial bones

† The points or "centres" in which the formation of bone has taken place and the extent to which these centres have developed

‡ The *epiphyses* are the processes of bone attached by cartilage

§ The *pelvis* is the cavity formed by the hip bones

|| *Talipes* is the deformity commonly called 'club foot"

¶ *Wens* are small cystic swellings varying in size from a millet seed to an orange, situated in the skin or tissues immediately beneath the skin.

(b) From operations (major operations also bleeding and cupping, leech bites, setons, etc)

(c) From tatooing or flogging

(d) From natural causes (discoloration, nævi,* moles, warts)

(e) From violence

(f) *From stains (such as blood, etc)*

(9) Injuries—

(a) Fractures

(b) Dislocations

(c) Wounds Consider (1) their probable origin, (2) position, and (3) extent, etc

Examine now in detail the various parts and organs of the body

(10) The Head—

(a) Complexion (fair, dark, sallow)

(b) Shape and general type of face and head (European, Mongolian, etc)

(c) Forehead (low, high, prominent)

(d) Eyes (large or small, sunk or prominent)

(e) Nose (short or long, flat and broad, broad or well formed nostrils, etc)

(f) Ears (lobules well formed or continuous with the cheeks—pierced or not)

(g) Mouth (large or small, note scars on the roof and the conditions of alveolar processes)

(h) Lips—large or small (cicatrices)

(i) Teeth—

Number

Regularity

State of decay

Any special parts where they are more than usually worn away

* A nævus is a mark or blemish due to the dilatation of the blood vessels near the surface of the skin or within its texture

(3) The height of the person
(4) The weight of the person.

(5) Age—
- (a) The amount and colour of the hair
- (b) The teeth
- (c) The condition of the alveolar processes.
- (d) The condition of the fontanelles *
- (e) The points of ossification †
- (f) The condition of the epiphyses ‡
- (g) The size of the bones

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(a) Fractures.

(b) Dislocations

(c) Wounds Consider (1) their probable origin, (2) position, and (3) extent, etc.

Examine now in detail the various parts and organs of the body.

(10.) The Head—

(a) Complexion (fair, dark, sallow).

(b) Shape and general type of face and head (European, Mongolian, etc).

(c) Forehead (low, high, prominent).

(d) Eyes (large or small, sunk or prominent).

(e) Nose (short or long, flat and broad, broad *or well formed nostrils, etc*).

(f) Ears (lobules well formed or continuous with the cheeks—pierced or not).

(g) Mouth (large or small; note scars on the roof and the conditions of alveolar processes).

(h) Lips—large or small (cicatrices)

(i) Teeth—

Number.

Regularity.

State of decay.

Any special parts where they are more than usually worn away.

* A nævus is a mark or blemish due to the dilatation of the blood vessels near the surface of the skin or within its texture

Whether there are false teeth or indications exist of their having been worn

(j) Chin (full, round, double, pointed, or receding).

(k) Hair—

Amount, color, and length of hair on head, lip, chin

Whether the color be natural (test if necessary)

Whether it has been recently cut

(11) The Neck—

Its characters (short or long, thin or thick cicatrices)

(12) The Chest—

(a) Formation (well formed or pigeon shaped)

(b) Shoulders (high or sloping)

(c) Sternum or breast-bone (flat or sunk, etc.)

(13) Pelvis—

(a) The genitals normal or otherwise.

(b) In females the question of pregnancy.

(c) In the case of a skeleton, decide whether the pelvis be that of a male or female

(14) The Extremities—

(a) The arms—size and length generally

The fingers, short or long

Whether they are of proper proportioned length

Any peculiarities of the nails

The hands, rough or not by hard work

Whether marked or not by stains

(b) The legs—whether uniform or not in length

Anchylosis* of joints

Whether bowed or not

Whether knock kneed

The ankles and feet

* *Anchylosis* is a stiffness or immobility of joints arising from various causes

II —In the case of mutilated remains, the following special appearances should be noted in addition to what has already been stated —

Special appearances to be noted in case of mutilated remains

(1) The degree of accuracy with which the parts fit together as follows —

(a) Bones
(b) Muscles
(c) Blood vessels

(2) Nature of the mutilation —

(a) Whether the muscles are hacked or have been divided by a sharp knife
(b) Whether the bones have been chopped or cut with a fine or coarse saw

(3) The after treatment to which the parts have been subjected —

(a) Whether they have been acted upon by lime or other chemicals

(b) Burning—

If the bones be entire, examine as usual
If only an ash be found, examine this for phosphate of lime

(c) Boiling

III —The following details should be noted in the case of the discovery of a skeleton or of individual bones, in addition to the points already indicated —

Notes in regard to a skeleton or individual bones

(1) The extent to which the soft parts have disappeared
(2) The extent to which separation of the bones has taken place
(3) The colour of the bones
(4) Their state of preservation
(5) Are they human or not
(6) The sex as determined from the pelvis and the characters of the bones generally
(7) Do the bones belong to one or to more than one body

(8) *Carefully examine the pelvis and the parts* around for the remains of fœtal bones

(9) Examine carefully for any evidence of disease of the bones (Special diseases—anchylosis, *rickets, syphilis, softening, etc*)

(10) Existence of injuries

Clothes or ornaments may aid in establishing identity

41 The clothes or ornaments found on a body may aid in establishing its identity In the case of natives of India, the following points should be specially noted —

In males —

(1) If the native coat (*angarka or chapkan*) is worn, whether this fastens on the right side (= Hindu), left side (= Mahomedan), or centre (= Parsees, Jews, and some Hindus)

(2) If a sacred thread is worn, whether this passes over the left shoulder and under the left arm pit (= Hindu), or is worn round the waist (= Parsee)

(3) If a necklace of beads is worn, the material of which they are composed should be noted If these are of wood, or if the beads are nuts or seeds, the wearer is probably a Hindu

(4) It may be also noted that unless both ears are pierced, the individual is not a Hindu

In the case of females it should be noted—

(1) Whether trousers are worn or not—trousers with a sacred thread indicate a Parsee, without, a Mahomedan

(2) Whether there are bangles on the wrists or not An adult female without bangles is probably a Hindu widow or a non Hindu

(3) Whether the nose ring is passed through a perforation in the septum (= Mahomedan), or through one in the left ala (= Hindu)

(4) Whether the head is shaved or not A female

with the head shaved is probably a Hindu widow *

42 In the *Indian Medical Gazette* of 1875, January 1st, several remarkable cases of identification are recorded — Remarkable cases of identification

(a) An adult male, *æt* 45 years A fracture of the sternum, without any appearance of union, bony or otherwise, and rupture of the intercostal muscles, with extensive extravasations of blood at the seat of fracture, were clearly made out at the *post mortem* on a body far advanced in decomposition The appearances indicated violence before death, and moreover that the person did not long survive the injuries inflicted

(b) A comminuted fracture of the skull discovered in an exhumed and exceedingly putrid body Prisoner convicted

(c) A fractured skull, with a penetrating wound of the abdomen, clearly made out in "an enormously bloated and maggot eaten body"

(d) Identity established in a body almost skeletonised, by the remains of a cartilaginous tumour of the neck

(e) Identity determined *from mere fragments* of what had been a body (æt 8 years) by the hair on the back of the head and the absence of the left lateral incisor Prisoner convicted

In the same paper, at page 5, a case is given where identity was determined from a skull, five ribs, and five vertebræ The teeth and the peculiar shape of the skull were of importance in connection with identification in this case, that of a boy nine years of age

43 After the identification, the different heads enumerated at pages 12 to 14 should be invariably discussed in detail, and it must be remembered that any evidence which may be afterwards brought forward regarding the condition Subsequent evidence regarding wounds

* From Lyon's *Medical Jurisprudence for India* 2nd Ed, p 2.

of the body or the nature of the wounds, is looked upon with great suspicion

Evidence as to whether wounds caused before or after death

44 In order to be able to decide whether the death has been caused by wounds, it is necessary that there should be some evidence as to whether the wounds were caused before or after death This is a question which the medical officer who inspects the body will be best able to decide, but still there are some circumstances which it is absolutely necessary the village authorities should note

Wounds caused after death

45 In open wounds caused after death—

(1) bleeding may occur, but it is never very copious,

(2) what does occur is venous, and is of a thin fluid character,

(3) the edges of the wound are loose and close,

(4) there is no coagulation of the blood

Distinguishing features of wounds inflicted before and after death

46 The following table gives in general terms the distinguishing features of a wound inflicted before and after death, and contrasts them —

BEFORE DEATH	AFTER DEATH
1 Retraction of the skin	1 No retraction of skin
2 Hæmorrhage always arterial * Edges of the wound injected	2 Venous hæmorrhage * Edges of wound not injected
3 Edges of wound everted	3 No eversion of the edges except from putrefaction or in fat people
4 Blood clots large	4 Only small clots, if any

This table is given as a guide, for it should be borne in mind that it is by no means easy to decide whether the wound was inflicted before or after death

Suspicion thrown on enemies of deceased's family in cases of natural death

47. Cases have occurred (see Illustrative Case VI) in which persons have died a natural death, but after death wounds have been inflicted, and the body has then been placed so as to throw suspicion on an enemy of the deceased's family In such a case as this, it would probably be easy to detect whether the wounds had been caused after death, but when death has been caused by one act of violence and other

* *Arterial blood* is bright red, *venous blood* dark red in colour

wounds are inflicted immediately afterwards, the symptoms given above will often be less marked

48 The retracted nature of the vessels, and of the edges of the wound, is one of the safest signs of the wound having been caused during lifetime This is a point which a medical man can better decide than a village magistrate, and it should, therefore, be an invariable rule that, however apparent the cause of death may seem to be, wherever it is clear, or wherever there is even a suspicion, that violence of any kind has been used, *the body should be invariably sent to the nearest dispensary or hospital* This, owing to the establishment of a dispensary in almost every *taluq* of every district, has been of late years made possible A few years ago, when there was generally only one hospital in a district of several thousand square miles, it was often impossible. Still, however, cases frequently occur in which bodies, where death has clearly been caused by violence, are not sent for medical examination

Retracted vessels safest sign of wounds caused during life time

49 When the body is examined at the hospital, great care and attention must be bestowed upon all these points There are definite rules regarding how a *post mortem* should be conducted, which will be dealt with in a subsequent chapter The medical officer's duty lies exclusively with the body itself the stomach and intestines he has nothing to do with, they must be sent to the chemical examiner The necessity of care and cleanliness in the disposal of the stomach, etc, is pointed out further on, but a case may be here alluded to, quoted by Beck, in which a stomach was negligently laid on some fine white sand At the subsequent examination particles of this were found, and gave rise to an idea of poison by means of powdered glass As, however, these particles must necessarily have been found outside the stomach, it is presumed that this idea was soon dispelled

The *post mortem* examination

50 If there are wounds on the body, note carefully their size and description and the direction in which they run, having especial regard to any facts which may lead to

Size and description of wounds to be noted

forming an opinion as to whether they were caused before or after death.

Has the wound been inflicted before or after death

51. Hæmorrhage* is generally supposed to be *primâ facie* evidence that life was present when the wound was inflicted. This, however, is not always the case, because hæmorrhage may in some cases be observed in a dead body, as, for instance, in cases of hæmorrhagic apoplexy† and in a few varieties of protracted or malignant fever. In these instances, however, it is of a dark colour, and evidently more fluid and venous than in a natural state. There will also be an absence of coagula or clots of blood. Again, blood sometimes flows from an incision in a dead body and sometimes even from a touch, which no doubt gave rise to the idea of a corpse bleeding if the murderer touched it. Bleeding, therefore, is no proof that the wound from which the blood comes was caused on the living body. "But" (says Beck) "hæmorrhage may be wanting (from the wound), and on dissection the blood is found fluid in the heart and its large vessels—the spinal canal, the lungs, or the brain. Is this to be deemed a proof of violent death? I apprehend not. All that can be said is that fluidity is most common in such cases, as from narcotic poisons, lightning, and the like, but it is also observed in sudden death from ordinary causes, and particularly in apoplexy, and even is occasionally not wanting in the usual forms of disease that come under the examination of the anatomist."

Bruises or contused wounds

52. The same remarks refer to bruises, and a careful examination is required in order to decide whether they have been caused before or after death. It is a settled point, that, unless caused immediately after death, a blow is not capable of causing ecchymosis. Casper has shown, by a

* *Hæmorrhage* is the bursting forth or flowing of blood from blood vessels, from whatever cause.

† *Apoplexy* is a term applied to a morbid state, in which both sense and motion are suddenly arrested, the patient lying as if asleep; but respiration and heart's action continuing, the breathing is noisy or stertorous and the pupils are generally dilated. Apoplexy is usually due to hæmorrhage into the substance of the brain; it may also be caused by pressure on or within the brain.

number of careful experiments, that, in the same way, the application of fire is not capable of causing on a dead body the appearance of vesicles* caused on a living one It is, however, of importance to remember that although blows inflicted shortly after death will imitate contusions caused during life, still they will only imitate *slight* contusions

53 A severe blow caused after death will only produce the same appearances as a slight contusion caused during life If, therefore, it is palpable that the blow has been a severe one, and the appearances one would naturally expect from a severe blow are wanting (such as swelling from the extent of the extravasation, a yellow margin round the black mark, effusion of blood into the cellular tissue, and an incorporation of blood with the whole true skin, rendering it black, and increasing in firmness and resistance), there can be no doubt that the blow has been dealt after death, even though there may be ecchymosis

Difference between a blow caused before or after death

54 It cannot however, be taken as a hard and fast rule, that blood after death will not coagulate, for Dr Christison stated, in his paper on the effects of blows after death, that he has known blood to coagulate firmly eight hours after death, and to have seen blood coagulate as it flowed in a *post mortem* examination—in one case, twelve hours after, and in another upwards of thirty hours after death

Rule not to be taken as a hard and fast one

55 But it may be accepted as a certainty, that after the body has become cold, and *rigor mortis* has set in, *i e*, about three hours after death, the muscles have acquired rigidity, and that therefore a blow, however severe, would leave none of the traces caused by a blow administered before death

Certainty of the rule as regards a blow given after *rigor mortis* has set in

56 As a general rule, open wounds, if received before death, are marked by red, bloody, and separated edges, and

Appearance of wounds inflicted during life

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* *Vesicles* are small blisters or bladder like elevations on the surface of the body

present a gaping appearance Blood is also more or less collected in the cellular tissue *

Appearance of wounds inflicted after death

57 Wounds inflicted after death are livid and their edges close together, and if there is blood to be found in the wound, it will be of a liquid venous character

Case of judicial murder of innocent man

58 As a proof of the care which is required in the conduct of a *post-mortem*, and the terrible results which an omission, or an error of judgment, may entail, see Illustrative Case No V (of Montbailly), in which the failure to correctly judge certain symptoms led to the judicial murder of an innocent man

Position and course of wound to be described

59 The course of a wound and its position is very often of the greatest importance in determining whether the act that caused death was one of murder or of suicide For instance, it is most improbable that a right-handed person could inflict a suicidal wound which runs from right to left, and, again, homicidal stabs run generally from above downwards The case of Gardner, already quoted, is a very interesting one on this point, and a somewhat similar case was tried at Cuddapah in the April sessions of 1884 (see Illustrative Case No VII)

Rules adopted in Europe regarding period of death not applicable to India

60 Rules, which experience in Europe has caused to be adopted regarding the period when death occurred, are scarcely applicable to this country, where the different stages a dead body passes through are so much more rapid than they are in a cold climate It is, however, certain that decomposition sets in much earlier in an injured than in an uninjured body, and commences first in the injured portions. The result of this is that the injuries appear to be of a much more aggravated form than they ought to be considered by a medical jurist (Taylor)

Death where there is no internal or external mark of injury

61 Where death has occurred, and there is no external mark of injury, the opinion of the medical officer should

be expressed only after most careful examination of all the parts There are numberless recorded cases in which, after a quarrel or a struggle, sudden death has taken place owing to the rupture of some internal vessel or organ, brought on by excitement or sudden passion When the cause of death cannot positively be ascribed to any injury, external or internal, or to any disease, the stomach and intestines should invariably be forwarded to the chemical examiner, but even when no cause of death can be discovered in the *post mortem*, nor any trace of poison in the stomach, it may happen that death has been caused by violent means

62 Accordingly, death may be caused by a shock* to the nervous system by means of violence, which, however, may leave no trace, either external or internal This is often the case where there has been a blow on the upper part of the abdomen, or on the pit of the stomach, and "it is admitted by experienced surgeons that a person may die from so simple a cause without any mark of a bruise externally, or physical injury internally, to account for death On the skin there may be some abrasion or slight discoloration, but, as it has been elsewhere stated, these are neither constant nor necessary accompaniments of a blow" (Taylor) In cases of this kind there may be other evidence to show that violence was used and was the cause of death

Death from shock

Thus, a trial took place at the Liverpool Autumn Assizes, 1837, wherein several persons were charged with the manslaughter of the deceased, by kicking him behind the right ear The medical witness deposed that there was in this spot the mark of a severe contusion, but there was no injury whatever to the brain, and the body was otherwise healthy He very properly ascribed death to the violent shock* given *to the nervous system, and the court held that the cause* of death was satisfactorily made out The person who inflicted the injury was convicted

* The term *shock* is used by medical men to denote the condition of grave vital depression produced by severe injuries occasionally after surgical operations or as the result of strong emotions

De tl from squeez ng of testicles

63 Another kind of injury common in this country, which is calculated to cause death by shock, is the squeezing of the testicles This, however, is generally accompanied by other injuries, and is alluded to under the head *Suffocation* Where there are many wounds or marks of injuries, it is not necessary to prove that any one in particular was sufficient to cause death, for the shock to the system caused by a number of blows, not one of which would in itself be fatal, has often been proved to be sufficient to cause death *

Death of wou d ed perso s from natural c uses m staken for violence

64 Dr Taylor s remarks on this head are of such importance, and especially in India where, in the majority of cases, prisoners are undefended by counsel, that they are given *in extenso* "It is by no means unusual for individuals who have received a wound, or sustained some personal injury, to die from latent natural causes, and as in the minds of non professional persons, death may appear to be a direct result of the injury, the case can only be cleared up by the assistance of a medical practitioner Such a coincidence has been witnessed in many cases of attempted suicide A man has inflicted a severe wound on himself while labouring under disease, or some morbid change tending to destroy life has occurred subsequently to the infliction of a wound, and death has followed Without a careful examination of the body, it is impossible to refer death to the real cause The importance of an accurate discrimination in a case in which wounds or personal injuries have been caused by another, must be obvious on the least reflection A hasty opinion may involve the accused in a charge of manslaughter, and although a barrister might be able to show on the trial that death was properly attributable, not to the wound, but to co existing disease, yet it must be remembered, that the evidence of a surgeon before a coroner or magistrate, in remote parts of this country (England), may be the means of causing the person

* See Taylor Vol I page 666 Refer also Reg v Jones Warwick 1831; Reg v Sayers C C C A g, 1841 Reg v Laws Norwich Lent 1854

charged to be imprisoned for some months previously to the trial In a case reported by Dr Berncastle, the deceased, a boy, died from an internal strangulation of the intestine from morbid causes after wrestling with another boy, who might, but for a careful inspection of the body, have been erroneously charged with having caused his death"

65 On the other hand, death may often occur from wounds after long periods, and the wounds may be the actual cause of death, *though, perhaps, some other act of violence* may be the apparent cause Thus, a case is related by Sir A Cooper of a gentleman who died of an injury to the head received about two years previously Taylor says that the longest interval at which a conviction has taken place from indirectly fatal causes is nine months (Under this head see Illustrative Case No IX) **Death after long periods**

66 This is a question that is always asked in court, but is one which it is not always possible to answer It is, of course, easy to say that an incised or clean cut wound has been caused by a sharp cutting instrument, a punctured* wound by a pointed one, and a contused wound† or a fracture by a blunt weapon, but when the question goes further and it is asked whether a particular weapon caused a particular wound, the answer can seldom be given with certainty In this respect, it is necessary to remember that, owing to the contracting power of the skin and of the flesh, an incised or punctured wound, such as a stab, will always appear to be smaller than the instrument by which it has been inflicted In the case of a cut (as, for instance, throat-cut) or a slash with a sword or bill hook, the size of the wound depends to a great extent upon the amount of force used, and a small knife may inflict as large a wound as a big **By what kind of weapon was the wound caused**

* *Punctured wounds* are those produced by long narrow and sharp pointed bodies penetrating it to the flesh As examples we have wounds produced by treading on a splinter of wood or a nail or the wound produced by the stab of a stiletto

† *Contused wounds* or bruises are those produced by blows with blunt weapons There is no solution of continuity or breach of the surface.

sword, but it often happens that the wound itself will afford evidence as to what weapon could *not* have been used. If the weapon produced is a sharp knife, and the edges of the wound are jagged, torn, and lacerated, it can be safely inferred that the wound was not caused by the knife, and the reverse is equally true. If the weapon is blunt with notches, and the edges of the wound are clean and show none of the signs which are to be found in wounds caused by a blunt instrument, it is clear that some sharp weapon has been used. When, however, the appearance of the *wound corresponds with the weapon produced*, all that can be said is, that the wound *might* have been caused by such a weapon. It is in the power of a professional witness to declare positively that the wound could *not* possibly have been caused by the weapon shown to him, but it is not in his power to state positively that the weapon shown him *did* cause the wound.

Difficulties in regard to fractures greater than in the case of wounds

67. As regards fractures, the difficulty is even still greater. Bones vary in strength in different persons. The bones of some persons are so exceedingly brittle that they are capable of being fractured by a very small blow from a very light stick. The same refers to the skull, which, with some persons, is much thicker than with others.

The rice-pound er a common weapon of assault in the Madras Presidency

68. A very common weapon, which is in the Madras Presidency used in sudden assaults and quarrels, especially between men and women, is the rice-pounder. It is very strange, but Dr Norman Chevers makes no mention of wounds caused by this deadly weapon, and we can, therefore, only suppose that in the north they are of rare occurrence. The rice pounder is generally made of hard wood, is about three and a half feet long and about one and a half to two inches in diameter, and at one end it is shod with a thin but strong iron plate, about an inch or an inch and a half in length. A strong blow from a weapon of this kind is almost certain death, and if, as is generally the case, it falls upon the head, a terrific fracture of the skull is the result. It often occurs, however, that the assailant is not

content with inflicting one blow, but strikes two or three, sometimes dashing out the brains of his victim and fracturing the skull to pieces In some cases, a single blow from a weapon of this kind will produce a clean cut in the skull difficult to be distinguished from a sword cut Murders with a rice pounder are generally the result of a quarrel, in which one or both the parties concerned have made use of the foul terms of abuse which are so common amongst the lower classes in India and, as far as we can judge from my own experience, and from a perusal of the printed reports of the Foujdaree Udalut and High Courts, are most common in the so called Ceded districts,—Bellary, Kurnool, and Cuddapah,—though they also occur occasionally in the other districts

69 Where death has been caused by one or a number of blows, a description of the wounds is of importance as likely to throw light upon the amount of violence used, and therefore upon the intention of the offender As has been said before death from a rice pounder is often the result of a sudden quarrel, but the weapon itself is of so imminently deadly a nature, that it must be in the knowledge of any person of ordinary understanding that a blow from such a weapon is likely to cause death, so that unless grave provocation can be shown, the offender is generally found guilty of murder, it is, however, usual in such cases for the judge to recommend a mitigation of punishment Thus, in the February sessions, 1884, at Cuddapah, a man was convicted of causing the death of a woman in this manner The prisoner was quarrelling with and beating his wife, when the deceased, his aunt, interfered and expostulated with him The prisoner seized a rice pounder, struck the deceased three times on the head and thrice on the body The head was smashed to pieces, and a part of the brain protruded Death after the first blow appears to have been instantaneous The judge found the prisoner guilty of murder and passed sentence of transportation for life, but, at the same time, recommended to the High Court a miti-

Presumption of intention from the weapon and violence used

gation This sentence was confirmed on appeal, and a reduction to five years' rigorous imprisonment was applied for

The lathi the commonly used in Bengal

70 In Bengal, the weapon with which fractures are most commonly caused appears (according to Dr Chevers) to be the *lathi*—a long thin bamboo used by most natives in walking and frequently furnished at one end with a small iron ferrule A weapon of this kind is also calculated to inflict a severe wound, especially upon the head, but the use of it is not so imminently dangerous to life as is that of a rice pounder, and the intention of the offender will, therefore, be best shown by the amount of violence used It should, however, be remembered that, when once the passion of a native is aroused, so far as to strike a blow, he seems to be often seized with a kind of frenzy for blood, and goes on striking long after his victim is dead When in this state of passion he is probably incapable of judging of the consequence of his acts, and it will be a matter for evidence whether this passion has been excited by grave and sufficient provocation

Causing death in self defence

71 The privilege of causing death in the exercise of the right of private defence, continues only as long as the danger to person or to property exists Any violence used, after such danger, and with it the right of defence has ceased, is a criminal act Thus, if a man is attacked by a thief or a robber, and he disables him with one blow without killing him, the danger to him has ceased, and he would not be justified in inflicting a series of other blows, and if, by so doing, he caused death, he would be legally responsible In a case of this kind, however, this blood frenzy which is so often excited, would probably be taken into account in awarding the punishment For a somewhat interesting and novel case of this kind, see Illustrative Case No X, and see also case reported at page 18

ILLUSTRATIVE CASES.

CASE No I —NON IDENTIFICATION OF REMAINS

Reg v Sundanem

DECEASED was induced by two others to leave his village under the pre text of looking for stolen cattle On the way he was murdered On the fourth day the remains were found—"His skull in three or four places, grey hairs, a pair of shoes, and a bag with flint and steel The jackals, vultures, etc., *had nearly picked the bones clean*"

There was circumstantial evidence, and the sentence was—*death* to first prisoner, transportation for life to second —(*Madras Reports of Foujdaree Udalut*, 1859) Madura, May to June, 1859

CASE No II —NON IDENTIFICATION OF REMAINS

Reg v Mahabalaya

DECEASED was a Brahmin, who had been sent to cash a *hoondee* (or cheque) This was on a Friday He did not return, and on the following Wednesday the remains of a man, with a Brahminical thread, were found "The witnesses could not identify the body, as the features were entirely decomposed" Some cloths near the body were identified, and certain persons who had been last seen with deceased were, on the strength of circumstantial evidence, convicted

The sessions judge recommended transportation for life, because the body had not been clearly identified, but the High Court (Foujdaree Udalut) seeing no reason to doubt that the remains were those of the missing man, sentenced to *death* —(*Madras Reports of Foujdaree Udalut*, 1859) Honore, June 1859

CASE No III —CAUSE OF DEATH DOUBTFUL

Reg *v*. Munisami Chetty

IN this case the prisoner was the brother of the deceased, and was charged with having killed him by stabbing him in the eye with a style An eye witness spoke to having seen the prisoner stab the deceased in the left eye with a style, and, on interfering, to have received a stab in the breast Other witnesses spoke to having seen blood issuing from the eye after death Death followed very rapidly The body was examined in the hospital two days afterwards One dresser or hospital assistant said that the body was so swollen that he could not discover any wounds; he opened the left eye and temple, *but without any results* Another dresser stated that he saw "a small wound in the corner of the left eye, which he believes to have been the result of a puncture by a needle" The *zillah* surgeon examined the skull eighteen days after death, and found nothing unnatural about the osseous structure of the orbital cavity, but admitted that there was a fissure through which the style might have been forced to the brain

through the eye ball, but could not speak with certainty owing to the advanced stage of decomposition

Verdict —Guilty of causing death in the manner described

Sentence —Three years' imprisonment with hard labour

In this case it is difficult to understand how a stab of such violence, as to cause almost instantaneous death, could have left such very faint traces There were, two days after death, when decomposition could scarcely have set in no other marks of injury on the body In this case a description of the wound by the village authorities should have been made The examination by the dressers seems to have been scarcely satisfactory —(*Madras Reports of Foujdaree Udalut*, 1861) Chittoor, August 1861

CASE No IV —CAUSE OF DEATH PRESUMED —(DEATH FROM SHOCK)

Reg *v* Kolorkandiyilo Ramotti.

IN this case it was alleged, on the one hand, that the deceased had died of cholera and, on the other, from the effects of a beating he had received the evening before No *post mortem* was made, several witnesses proved the beating, and others, whose statements contained contradictions, spoke to vomiting and purging The judge (Mr Holloway) remarked —"I am satisfied with the assessors, that, after this beating, the deceased, a man in good health, lay down greatly enfeebled, that he never recovered from its effects, and that he died of this beating early next morning" The judge disbelieved the evidence regarding the cholera, and, quoting Dr Taylor, presumed that death followed from exhaustion and a shock to the nervous system The body appears to have been quickly buried with the knowledge of the village authorities, who are supposed to have connived in representing the death as from cholera

In the case above quoted, the accused were found guilty of having caused the death of the deceased by beating, and were sentenced to three, five, and one year s imprisonment, respectively The sentence was confirmed by the High Court

A proper inquest and mahazarnamah drawn up by the village authorities would clearly have been more satisfactory

As bearing upon this, a case may be quoted which occurred within Mr Gribble's experience During the famine of 1876 77, the officer in charge of the relief camp at Madanapally, paid the camp a visit at night in order to see whether everything was in order The camp was composed of straw and thatch huts, and the orders were that no lights should be allowed anywhere, except in the kitchen, which was built of brick. One of the warders was found asleep with a light in his hut—a lean to—which he had thrust under the straw of the roof from which the flame was an inch or two distant The officer pulled the man out, gave him a sound beating on the posterior with his hunting thong, and turned him out of the camp On his way to the town, which was about two miles distant, the man was seized with cholera, and died of this disease early next morning in hospital.—Tellicherry, September 1861

CASE No V —CAUSE OF DEATH MISTAKEN

A WIDOW named Moutbailly, of inebriated habits, was found dead in her room, lying on a trunk with sharp edges Thirty two hours after death the body was inspected by a physician and surgeon, who reported that they found ecchymosis and contusions on the arms thorax, and particularly over the third, fourth, and fifth ribs The neck and upper part of the breast were also ecchymosed The head was swelled, blood was extravasated under the skin of the face, and the nose was filled with clotted blood On the eyelid there was a wound of nine or ten lines in extent, which penetrated to the orbit, and which might have been caused by a sharp or cutting instrument, but could not, in their opinion, have produced sudden death It was reported that the wounds might have been caused either by severe blows or by a fall A physician, who was present at the *post mortem*, but who took no part in it, gave evidence that the eye was ecchymosed, and that the edges of the wound were irregular and indented

This evidence, together with proof of frequent quarrels between deceased and her son and daughter in law, who lived in the same house, led to the conviction of the latter The son was broken on the wheel, but the daughter in law, owing to pregnancy, obtained a respite During the interval, the celebrated Dr Louis was consulted, and the result of his investigation was that there was no proof of the commission of murder, but rather of death from apoplexy, or some other cause The following were amongst his reasons for this opinion Intemperance predisposes to sanguineous* apoplexy, and the head of the deceased should have been opened in order that the condition of the internal parts could have explained the cause of the hæmorrhage A person in a state of intoxication, and, therefore, predisposed to apoplexy, would, on falling against any sharp edged substance, naturally lose a considerable quantity of blood, and also have the arteries and veins of the head much distended It was held impossible that hæmorrhage from the wound in the eye could have caused death As to the ecchymosis, or livid spots on the thorax and arms which were attributed to blows or a fall, M Louis observed that *they were the ordinary appearances found on those who die in a state of intoxication* The result of this further medical evidence was that the former decision was revoked, and the memory of the executed son was exonerated two years after his execution (1772) —*Case quoted by Beck*

CASE No VI —MUTILATION OF BODIES AFTER DEATH

DR NORMAN CHEVERS quotes several cases of this kind This mutilation is caused either to prevent identification, as in the case of a wounded thief decapitated by the other members of his gang, or else to throw suspicion upon innocent persons There are many instances of the former That given by Herodotus, of a thief caught in a trap whilst plundering the king's treasury, and who begged his brother, who accompanied him, to cut off his head, is probably the oldest on record Similar cases have occurred in Bengal, and are quoted by Dr Chevers, *ex gra* In August 1869, the papers reported a daring dacoity in the village of Hasalong in Lohardugga. The

* Or hæmorrhagic apoplexy

robbers were chased by the zemindar and a fight ensued, in which two of the gang were badly wounded. Their comrades, however, succeeded in cutting off and carrying away their heads, so as to prevent identification

REGARDING mutilation of dead bodies, in order to throw suspicion on innocent persons there are also several recorded instances "Ill will having for some months existed between a ticcadar of Patna and his ryots, the latter resolved to bring him into trouble With this view they murdered Chumma Gowalah, an unfortunate cripple, and then laid his death at the door of the ticcadar Ten persons were tried, of whom two were hanged." —(*Chevers*)

IN the Nizamut Udalut Reports for Bengal, Vol VI, 1856, a similar case is reported from Tirhoot The body of a deaf and dumb beggar was found fearfully hacked and cut, leaning against the house of a person against whom the accused had a grudge Four persons were convicted by the judge, but were acquitted by the higher court In a copy of Dr Chevers' book,* the following MS footnote with reference to this subject was found "I remember in a case tried by the sessions court of Cuddapah (*circa* 69 or 70), where the defence was that deceased had been murdered to get the prisoners into trouble the judge (Mr Hutchins) disbelieved that anything so unnatural could have taken place, and severely reprimanded prisoner's counsel for adopting this line of defence"

A SIMILAR case occurred in Trichinopoly about twenty five years ago, of which we are unable to find the record In that case an old man induced his sons to kill him (telling them that he must anyway die soon), and place his body in such a place as to cast suspicion on a relative with whom the family was at enmity This was done and the trick very nearly proved successful, the relative being put upon his trial and narrowly escaping conviction He was, however, acquitted, and the guilty parties detected

"PROBABLY the most atrocious case of the kind on record is that of a woman in the Patna District, who poisoned *her own* little daughter, and having concealed her body on the premises of a neighbour with whom she was at enmity, accused him of having murdered her"—(*Chevers*)

AGAIN "It is a well known practice in India, where a death occurs suddenly from natural causes to a member of one or two rival houses, for his relatives to inflict various wounds upon the corpse and to place it in a spot, where it may be readily discovered, near their enemy's dwelling"—(*Ibid*)

CASE NO. VII —NATURE OF WOUNDS A TEST OF WHETHER THE CASE IS ONE OF SUICIDE OR MURDER

THE following case was tried at the April sessions of the Cuddapah court (1884) Hearing a noise in his neighbour's backyard, early one morning, before dawn, the person hearing it went and awoke the inmates On going to the backyard, the form of a person was seen leaving it and on going a little further, a female servant of the house was found lying in a pool of blood with her throat cut No weapon of any kind could be found near the body The woman was sensible but could not speak On the prisoner, a

* *Medical Jurisprudence in India*

servant of the same house, who slept in the backyard, being arrested and placed amongst others, she pointed him out as the person who had stabbed her Prisoner's defence was, that the woman had asked him to elope with her, and, on his refusal, had cut her own throat The woman was taken to the hospital and lived for several days The wounds were described by the medical officer as being from right to left There were two gashes, and in each the deepest part was to the right and the gash tailed off to the left The woman was right handed

Held.—That this could not be a case of suicide, as a right handed person would most improbably have used the left hand, would still more improbably have been able to inflict two gashes with the left hand, and if she had done so, some weapon must have been found near the body

Sentence —Death, which was confirmed by the High Court

CASE NO VIII —CASES WHERE THE REAL CAUSE OF DEATH WAS DIFFERENT FROM THE APPARENT ONE

IN March 1867, a woman, *ætat* 73, was charged with causing the death of a pauper, *by striking her on the cheek* *The deceased became insensible* and died in ten minutes On inspection, it was found that death had been caused by the rupture of an aneurism* of the aorta † The medical opinion was that the blow might have accelerated a fatal result of the disease —(*Taylor*)

IN another case (Reg *v* Champlonier, 1854), an old man passing on the road was struck on the forehead by a stone thrown by the prisoner There was a contused wound and the nose bled profusely The bleeding was arrested, and on the following day the man was considered out of danger. At a later period of the day, however, the deceased was seized with an apoplectic fit, from which he did not recover The appearance of the brain was sufficient to account for death, but the medical man could not undertake to say that the injury by the stone had in any way produced these appearances The prisoner was acquitted —(*Ibid*)

DR CHEVERS mentions many cases in which persons, who have first of all been killed, have afterwards been hung up so as to cause an impression that they had committed suicide; and a case only lately occurred in which the body of a man found hanging was, on dissection, proved to contain a large quantity of arsenic, thus rendering it probable that he had been poisoned before being hung up

CASE NO IX —DEATH AFTER LONG PERIODS ‡

IT is generally believed that wounds of the heart produce almost instantaneous death Various causes, however, may exist which prevent such

* An *aneurism* is a tumour swelling, or dilatation of an artery, the contents of the swelling consisting of blood

† The *aorta* is the great artery springing from the left side of the heart All the other arteries of the body, except the pulmonary artery, proceed mediately or indirectly from the aorta

‡ See also Taylor, Vol I, 61?. Reg *v* Sullivan, C C C, September, 1853

wounds from proving fatal for hours and days, and sometimes even for weeks

Dr Taylor mentions that out of twenty nine instances of penetrating wounds of the heart, only two proved fatal within forty eight hours In the others death took place at the varying periods of from four to twenty-eight days

DR CHEVERS quotes the case narrated by Mr William White of Rangoon A soldier was wounded in the storming of the Great Pagoda on 14th April, 1852 The ball entered a little above the anterior fold of the left axilla, taking an oblique direction to the cavity of the chest At first he appeared to be doing well, and the wound closed Subsequently, his health declined with feverish symptoms and evidence of pulmonary disease A few days before his death it was noticed that the action of the heart was weak but natural, its systole or contraction and diastole or relaxation regular and equal He died worn out and emaciated on the 24th June On examination the bullet was found in the left ventricle of the heart, in its most interior part

A RATHER peculiar case occurred at Calicut in 1857 Deceased was assaulted by the prisoner armed with a toddy knife, and terrible gashes were inflicted upon the head, neck, etc This was on 8th April Deceased was removed to the hospital, and there he died on the 21st May—*not* of the wounds, *but of dysentery* The apothecary deposed that "dysentery was the sole cause of death, but I am of opinion that he would have died from the number of wounds received and the necessary enfeebling of his constitution in consequence" The prisoner was convicted of wounding with intent to murder, and sentenced to imprisonment for life with hard labour —(*Reports of Madras Foujdaree Udalut, Vol VII*)

CASE NO X —DEATH CAUSED UNDER A FALSE PLEA OF PRIVATE DEFENCE

THE prisoner appears in the middle of the night to have raised an alarm that some one was breaking into one of the houses He at once went to the house, and, seeing a person creeping out of a hole in the wall, he attacked him with a bill hook and almost cut him to pieces He alleged, in his defence, that he had done this because he considered the man to be a robber. He had at one time been employed as a watchman in the village, but at the time of the occurrence was no longer so employed. It was proved at the trial that the prisoner and the deceased were two thieves A dispute had occurred between them, the quarrel had been patched up, and the prisoner induced the deceased to join him in the very offence at which the crime occurred When the deceased had got inside the house, the prisoner raised the alarm, and then as the deceased crept out of the hole in the wall, at once attacked him in so savage a manner that death must have been instantaneous Prisoner was found guilty of murder and sentenced to death; but, on appeal, this sentence was reduced by the High Court to transportation for life This case was tried at Cuddapah in the July sessions of 1863

CHAPTER V.

ON RESPONSIBILITY FOR DEATH

What is a mortal wound—Difference between the law in India and England—What is sufficient to constitute murder—Recorded cases of death from slight injuries—Responsibility of aggressor for consequences of an injury—Death arising from unskilful treatment of wound—Cases quoted of unskilful treatment—Cases in which death results from neglect of slight wound—Failure of injured person to call in medical aid does not exonerate accused—Effects of an unauthorised assault—Wound or hurt which hastens death in a person already diseased—Secondary causes of death—Patient dies from suffocation in case of cut throat—Difficulty in deciding responsibility of person when death due indirectly to injury caused by him—Difference between law in England and in India—Weapon used effects definition of murder—Tetanus—Caution necessary in forming opinion whether Tetanus caused by wound—Erysipelas—Delirium tremens—Death from surgical operations

AMONGST medical jurists there exists considerable diversity of opinion as to what constitutes a mortal wound

72 As far as we in India are concerned, there seems to be little necessity for entering into the controversy, and probably the safest thing to do will be to call those wounds mortal which actually cause death For the English jurist, the point would seem to be of interest only in order to decide whether or not an accused can be admitted to bail For instance, in the case of the *King* v *Salisbury* (1st Strange's Reports, p 547), a woman, accused of having stabbed a gentleman, applied that a physician of her own nomination should be present at the dressing of the wound in order to be able to satisfy the court that the patient *was out of danger, so that she might be bailed. Here, in* India, the main gist of murder and culpable homicide is the intention of the offender If a wound causes death, and was inflicted under such circumstances, or by such a weapon, as was likely to cause death, the offence will be murder or culpable homicide.

What is a mortal wound

Difference between the law in India and England

73 In England the law would seem to be different, and, according to Lord Hale, "if a man be wounded and the wound, although not in itself mortal, turn to gangrene* or fever, this is homicide in the aggressor, for though the fever or gangrene be the immediate cause of death, yet the wound, being the cause of the gangrene or fever, is held the cause of death—*causa causati*"

What is sufficient to constitute murder

74 Lord Hale says, "It is sufficient to constitute murder that the party dies of the wound given by the prisoner, although the wound was not originally mortal but became so in consequence of negligence or unskilful treatment"

Recorded cases of death from slight injuries

75 There are instances on record of persons who have died in consequence of very slight injuries for instance, a girl struck her leg against a wheelbarrow, a slight wound on the shin was produced, but constitutional symptoms set in, and she died of the ultimate effects of the wound a few days afterwards Had this injury been caused by another, he would, under the English law, as laid down by Lord Hale, have been guilty of homicide, but in India he would not be found guilty of murder or culpable homicide *Per contra*, if a person were to fire a pistol into a crowd, or, in striking at a man with a sword, were to inflict even a slight skin wound, and the wound were afterwards to mortify and cause death, he would be liable for murder, because the act in itself was so imminently dangerous to human life that he would be held liable for all the consequences of the act

Responsibility of aggressor for consequences of an injury

76 Here also Lord Hale's rule would apply, and if the wound caused death owing to the want of medical treatment, or even if it could be proved that the wound might not have proved mortal if treated better or differently, he would still be liable

Death arising from unskilful treatment of wound

77 "But," says Lord Hale, "it is otherwise where death arises not from the wound, but from unskilful appli-

* *Gangrene* is the mortification or death of a part of the body from failure in nutrition

cations or operations used for the purpose of curing it" This distinction, it will be observed, is a very nice one, and Dr Taylor remarks "In slight and unimportant wounds it might not be difficult to distinguish the effects resulting from bad treatment, from those connected with the wound, but there can be few cases of severe injury to the person, wherein a distinction of this nature could be safely made, and the probability is that no conviction for murder would now take place if the medical evidence showed that the injury was not originally mortal but only became so by unskilful or improper treatment" (See Illustrative Case No XI)

78. In works on Medical Jurisprudence several cases of unskilful treatment are given in illustration, of which we may quote the two following — Cases quoted of unskilful treatment

In the case of *MacEwan*, Perth, September, *circ* 1830, the prisoner was indicted for the manslaughter of a boy, by striking him a blow on the shoulder, which dislocated the shoulder joint Two days after the blow, an ignorant bone setter was consulted, and, owing to his manipulations, inflammation took place, and the boy being of a scrofulous* habit, this proved fatal In another case (*Reg* v *Kingshott*—Lewes Summer Assizes, 1858), a man in a quarrel received a bite on his thumb He went to a quack, who applied some irritating ointment, which led to severe inflammation, and this rendered amputation necessary, from the effects of which he died There was evidence that the original injury was slight, and would probably have healed but for the improper applications In both these cases the prisoners were acquitted In this country, in the former case, the prisoner would certainly have been liable to punishment for causing grievous hurt, and probably for simple hurt in the latter case

Cases in which death results from neglect of slight wound

79 In India, it is frequently impossible for a native to get any medical assistance whatsoever, and there might occur many cases in which, owing to a slight wound not having been treated, inflammation and death might supervene In all such cases the test would probably be—Under what circumstances, and with what kind of weapon, was the injury caused?

Failure of injured person to call in medical aid does not exonerate accused

80 The mere failure of the injured person to call in medical assistance would not be sufficient to exonerate the accused, for, in the case of *Governor Wall*, the Lord Chief Baron, in charging the jury, observed that no man was authorized to place another in so perilous a predicament as to make the preservation of his life depend merely on his own prudence The same has been ruled in another case (*Bennett v Gredley*, Exchequer Sittings, Hilary Term, 1854), where there was a suit for compensation by reason of injuries inflicted on a boy's arm It was argued in defence that the state of the arm was partly owing to a former injury, but the Chief Baron remarked that a man was not bound to have his body in so sound and healthy a state as to warrant an unauthorized assault upon him

Effects of an unauthorised assault.

81 A man, therefore, who commits an unauthorized assault upon his fellow man, must take the chance of the effects such an assault may produce "So, if the person mal treated be an infant or an infirm old man, or one labouring under a mortal disease, it is notorious that a comparatively slight degree of violence will destroy life in these cases, and the prisoner would be properly held responsible A wound which *accelerates* death, *causes* death, and may therefore render the aggressor responsible for murder or manslaughter, according to the circumstances" (Taylor)

Wound or hurt which hastens death in a person already diseased

82 According to Lord Hale, if a man has a disease which, in all likelihood, would terminate his life in a short time, *and another gives him a wound or hurt which hastens his death*, this is such a killing as constitutes murder This point is of especial interest in India, where so many persons suffer under an enlarged spleen, which is liable to

rupture on the infliction of a very slight blow As stated above, the test would probably be the circumstances under which the blow which caused the injury was struck It would probably be held that a kick, or blow with a stick, is an act so imminently dangerous that the aggressor would be guilty of having caused the death, if death—say by the rupture of the spleen—actually did occur A blow with the clenched fist might likewise be held to be dangerous in itself, but this could scarcely be the case in the event of a blow struck with the open hand In connection with this, a very nice point would arise Supposing such a blow from a kick, or a stick,—which would not, under ordinary circumstances, cause death,—caused a rupture, say, of the spleen, from which the person injured subsequently *recovered*, could the aggressor, who, in the event of death having ensued, might have been held liable or culpable homicide or murder, be held liable for *an attempt* to commit these offences? It is, perhaps, doubtful whether any Court would so hold him liable

83 A person who recovers from the immediate effects of a wound may die from fever, inflammation or its consequences, pyæmia,* erysipelas,† delirium tremens, tetanus‡ or gangrene,§ or from an operation rendered necessary in the treatment of the wound These are what may be called secondary causes of death, or secondary consequences of a wound (Taylor). Secondary causes of death

84 It frequently happens that in the case of cut throat, the patient dies from suffocation In Illustrative Case No VII, already quoted, where a woman's throat was cut, she died about ten days afterwards of inflammation of the lungs, brought on by the wound Patient dies from suffocation in case of cut throat

85 It may often become a point of considerable difficulty to decide upon the exact responsibility of a person, Difficulty in deciding responsibility of person when death due indirectly to injury caused by him

* *Pyæmia* is a form of blood poisoning, associated with the formation of secondary abscesses in various organs and tissues of the body

† *Erysipelas* is also called St Anthony's fire

‡ *Tetanus* also called "lock jaw"

§ Likewise called 'mortification'

when the death depends only in an indirect manner upon the injury caused by him In the case of death from injuries, therefore, however slight they may be, the accused should be invariably dealt with by the higher courts This, however, is by no means always the case Mr Gribble remembers one occasion (December 1870), in which, as head assistant magistrate, he committed a man to the sessions court of Kurnool on a charge of having caused the death of his wife, by having in a quarrel struck her on the side with a cob of Indian corn, thereby rupturing her spleen It was remarked by the sessions judge that this was a case which the magistrate could have disposed of himself The fact that death occurred should be sufficient to remove a case of hurt—even although, *primâ facie*, it may seem to be one of simple hurt—from the jurisdiction of the magistrate to that of the sessions court The responsibility of the aggressor in cases of death from secondary causes is a question which is very difficult to decide, and " it is impossible to lay down general rules on a subject which is liable to vary in its relations in every case, but where a wound is not serious, and the secondary cause of death is evidently due to constitutional peculiarities from acquired habits of dissipation, the ends of justice are probably answered by an acquittal ' (Taylor) In cases of this kind, however, the public prosecutor should be careful to add another charge, so that if the accused should be acquitted on the more serious charge of homicide, he may still be punished for the act which caused the injury

Difference between law in England and in India

86 The law in England and in India seems to differ in this respect,—that whereas in the former country the aggressor is held responsible for the death which may be the result of even a slight injury, in India he would not be found guilty of more than manslaughter This would be a point for the jury to decide, and it would be for the judge, in awarding the punishment, to take into consideration the circumstances under which the injury was inflicted and the intention of the prisoner Hence a person

may be found guilty of manslaughter, and an almost nominal punishment be inflicted.

Weapon used effects definition of murder

87. In India, however, the description of weapon used may, according to the definition of the Penal Code, make the offence necessarily one of murder, in which the judge has not the option of passing any other sentence than one of death or transportation for life. Hence the practice already alluded to and illustrated by the case from Cuddapah (where a man beat a woman to death with a rice pounder), in which, owing to the circumstances under which the injury that caused death was inflicted, the judge convicted of murder, but at the same time recommended a mitigation of the sentence—a course which the High Court held to be a proper one to adopt.

Tetanus

88. *Tetanus* is liable to occur as a secondary consequence of almost any kind of wound. It may not occur in cases where wounds of the most severe description have been inflicted; and, on the other hand, it may supervene when the wound is of the smallest and most insignificant nature. It is specially liable to occur in the case of lacerated or contused wounds, and has occurred as a result of even slight bruises. Dr. Taylor quotes the following cases:—"A man slipped and fell flat on his back. He was stunned, but was able to walk home. Next day he was attacked with tetanus and died in seventy hours." It has occurred as the result of a blow on the nose, and it sometimes occurs without any apparent cause whatsoever. Dr. Hehir has met with several instances in which tetanus has appeared in a severe form in persons who had received no wound, but who had been simply exposed to cold and wet,* or to inclement weather. He likewise relates a case in which a simple abrasion of the thumb produced tetanus in a strong healthy man.

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* Baynes says that natives of this country are not generally so liable to suffer from the secondary causes resulting from injuries as are people in Europe, *e.g.*, tetanus, erysipelas, etc. We entirely disagree with this opinion, and feel convinced that secondary effects of injuries are more frequently met with in India than in Europe.

Caution necessary in forming opin on whether tetanus caused by wound

89 It follows, therefore, that a medical witness should be exceedingly cautious before venturing an opinion as to whether tetanus has or has not been caused by a wound The body should be carefully searched in order to ascertain whether there is any other trace of injury to which the tetanus may be due Thus, in the case of a boy who was attacked by symptoms of tetanus soon after receiving a blow and a kick from another boy, and who ultimately died of this disease, it was found, on an examination of the body, that there was a recent scar on the ball of the great toe, and it was ascertained that six days previously he had driven a rusty nail into his foot which had caused suppuration,* and there could be no doubt that this, and not the slight blow struck, was the cause of tetanus Dr Taylor says "*It is scarcely possible to distinguish, by the symptoms*, tetanus from wounds (traumatic tetanus), from that which occurs spontaneously as a result of natural causes (idiopathic tetanus)"

Erysipelas

90 *Erysipelas* like tetanus, may be the result of slight injuries Some constitutions are more prone to it than others Erysipelas frequently occurs after wounds on the head, burns, and scalds Taylor says "The medical facts, that the person assaulted has never recovered from the effects of the violence, and that the inflammation set up has suddenly assumed an erysipelatous character, are sufficient to establish this connection" With reference to this disease, however, it should be borne in mind, that, unlike tetanus, the symptoms of erysipelas will show themselves in the injured parts, and it will, therefore, be easier to decide whether or not the disease has been caused by the injury (traumatic Erysipelas)

Delirium tremens

91 In the case of persons of intemperate habits, delirium tremens is often brought on by even slight injuries In illustration of this Taylor quotes *Reg* v *Heywood*, C C C, October 1846 Deceased was assaulted without any serious

* *Suppuration* is the process by which pus is formed

consequences Delirium tremens came on and he died in a few days The medical opinion was that death was attributable to a shock of the nervous system, causing delirium tremens and he accounted for that shock by the attack made on the deceased and the blows he had received In cross examination, he attributed the delirium tremens to both the blows and excitement The prisoner was acquitted This verdict would scarcely seem to be consistent with the Chief Baron's ruling quoted *ante*, that a man is not bound to have his body in so sound a state of health as to warrant an unjustifiable assault If the deceased had not excited him self previous to the assault, if the assault was an unjustifiable one, and the excitement was in consequence of it, it would seem as if the accused should have been held responsible

92 This point involves a question of great importance, *viz*, the responsibility of a medical man who, in the treatment of a person injured by violence, conducts an operation from the effects of which the patient dies The question is one of vital interest to medical practitioners For all practical purposes, however, it would seem that the two following questions only should be answered (1) Was, in the opinion of the medical attendant, the operation necessary for the preservation of life? (2) Was the operation properly conducted according to the best of the practitioner's ability and with due care and attention? If these two questions are answered in the affirmative, in the event of death resulting from the operation, it must be held to have been caused by the injury which rendered the operation necessary The operation must, however, have been necessary in order to save life If an operation was performed merely to prevent the signs of disfigurement caused by an injury and *death resulted, the person who caused the* injury could not be held responsible The same rule would apply where the operation had been conducted, not for the purpose of preserving life, but of preserving the use of some limb or member for instance, A causes an injury to B, in consequence of which it appears to the medical attend

Death from surgical operations

ant that unless an operation is performed, permanent loss of sight will follow. Danger to life is not apprehended, but merely to the organ of sight An operation is performed, in consequence of which B dies. In this case A could not be held responsible for B's death Even if it should be afterwards proved that life might possibly have been saved without an operation, this would not be sufficient to make the operator liable, if, after due care and the exercise of such science and knowledge as he was possessed of, he was convinced that an operation was necessary Of course, if it could be shown that, in conducting the operation, there was gross negligence,—as for instance, owing to an artery not having been ligatured or tied, the patient died from loss of blood, or, as in a case quoted by Casper, where a portion of the bowel was cut off in mistake for the *umbilical cord*,* and death ensued,—it would be necessary to hold that the operation was the cause of death, and not the original injury On this point, see Illustrative Cases Nos XVI to XVIII

* The *umbilical cord* is the vascular cord like structure connecting the placenta, or "after birth," with the fœtus during the stay of the latter within the womb

ILLUSTRATIVE CASES.

CASE No XI —ACCUSED HELD LIABLE FOR DEATH FOLLOWING AN OPERATION BASED ON A MISTAKEN DIAGNOSIS.

Reg v Pym

IN this case, a Lieutenant Seton had been shot in a duel A tumour* formed in the course of the pistol shot received by the deceased at the lower part of the abdomen, and this was supposed, by the late Mr Liston and two other surgeons, to be an aneurismal enlargement from a wound in, or injury on, the femoral artery † for which it was considered necessary to tie the external iliac artery ‡ The patient died from peritoneal inflammation following this serious operation, and on inspection, it was found that the tumour (the supposed aneurism) was formed by a mass of coagulated blood, poured out not from the femoral artery, but from one of its superficial and anomalous branches Counsel for the prisoner proposed to cross-examine the medical witnesses, in order to show that the wound was not dangerous to life, and the operation not absolutely necessary Erle, J, said "I presume you propose to call counter evidence and impeach the propriety of the operation; but I am clearly of opinion that if a dangerous wound is given, and the best (available?) advice is taken, and under that advice an operation is performed, which is the immediate cause of death, the party giving the wound is criminally responsible" Counsel replied that he was prepared to show that no operation at all was required, or, at all events an easier and much less dangerous one might and ought to have been adopted He submitted that a person is not criminally responsible where the death is caused by consequences which are not physically the consequences of the wound, but can only be connected with the first wound by moral reasonings Erle, J: "I am clearly of opinion, and so is my brother Rolfe, that where a wound is given, which, in the opinion of competent medical advisers, is dangerous, and the treatment which they *bonâ fide* adopt is the immediate cause of death, the party who inflicted the wound is criminally responsible, and of course those who aided and abetted him" The point was reserved, but as the prisoners were acquitted on other grounds, was not referred to the judges (Taylor) Dr Taylor goes on to remark, with reference to this case, "No operation would have been required but for the injury, and the prisoner ought not to escape on account of want of skill in a surgeon, or of a mistake by a skilful operator"—*Hant's Lent Assizes*, 1846

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* The term *tumour* is applied to an abnormal swelling or enlargement of any organ or part from any cause but usually from a morbid growth

† The *femoral artery* is the large artery of the lower extremity, which passes down the front and inner side of the thigh

‡ The *common iliac artery* is a large vessel which passes down along the flank bone on each side and divides into two branches, the *external* and *internal iliac arteries*

CASE No XII—CASES WHERE, IN INDIA, THE ACCUSED HAS NOT BEEN HELD RESPONSIBLE FOR HOMICIDE WHEN DEATH OCCURRED AS THE SECONDARY CAUSE OF THE INJURY.

Reg v Bysagoo Noshyo

ACCUSED quarrelled with his wife and gave her a kick, which ruptured her spleen He repented immediately and was found with the woman in his arms helping her Acquitted under Sections 320 and 322 of the Penal Code, but found guilty under Sections 319 and 321 Sentence One year's rigorous imprisonment —*Cal W R, Vol VIII, September* 1867

CASE No XIII

Reg v Robert Bruce

ACCUSED was tried for 'causing hurt' by kicking a boy who was suffering from diseased spleen Death was the result of the kick The judge held that the prisoner had no intention of causing death, but, considering the dangerous consequences of such an act, especially when inflicted on a native of this country, sentenced him to six months' rigorous imprisonment An Artilleryman —*(Calcutta Criminal Court, June* 1868 *)*

Taking into consideration the rulings given in the text, there can be little doubt that had these trials taken place in England the accused would, in some instances, have been found guilty of manslaughter

According to Lord Hale's ruling, quoted in the text, it would seem that an injury of this kind, which was the direct cause of death, would be sufficient to constitute murder "If a man," says Lord Hale, "has a disease which, in all likelihood, would terminate his life in a short time, and another gives him such a blow as hastens his death, *this is such a killing as constitutes murder*" Disease of the spleen, however, is not even a disease which need necessarily prove fatal In this country persons may live on without feeling any inconvenience from a diseased spleen, it is only when it is ruptured that it proves fatal

CASE No XIV—CASE IN WHICH ERYSIPELAS HELD NOT TO BE RESULT OF INJURY

A POTMAN, said to be of intemperate habits, was struck on the left cheek with a quart pot There was a contusion but no injury to the skin For thirteen days he suffered no ill effects, when erysipelas commenced On the same day he was attacked with delirium tremens On the sixteenth day erysipelas became general Death took place on the seventeenth day. At the trial the medical witness stated that it was not probable that erysipelas could supervene upon a contused wound thirteen days after a blow, and he expressed his opinion that in this case the erysipelas could not be attributed to the blow The accused was acquitted C C C, July 1859 —*(Taylor)*

CASE No XV—ERYSIPELAS THE RESULT OF AN ULCER AND NOT OF A WOUND

IN 1822, a gamekeeper was charged with the murder of a poacher, whom he shot in the left arm, which had to be amputated The man died of

erysipelas in the right leg, and the question was actually raised whether the erysipelas could have been caused by the gun shot wound It appeared that deceased had an ulcer in the leg attacked; had been for several days exposed, that erysipelas was prevalent in the infirmary, and deceased had been put in a bed occupied by a patient suffering under this disease. Prisoner was acquitted —(*Taylor*.)

CASE No XVI —DEATH BY SURGICAL OPERATIONS

THE case of Kelly is a remarkable one, as the verdict is utterly at variance with the law as laid down by the various English judges The deceased was a police constable, who had received a pistol-shot in the back of the neck and died four days afterwards. The medical attendant deemed it necessary to enlarge the wound in order to extract the ball During the operation nothing serious occurred to cause death. The bullet itself had "fractured and splintered the atlas * wounding and crushing the soft parts of the neck, and leading to the formation of an abscess" It was considered absolutely necessary to extract the bullet, and had this not been done, there can be no doubt that the death would have been attributed to neglect to extract it The prisoner was clearly identified, but in spite of this the prisoner was acquitted on the ground that the operation may have been the cause of death Taylor remarks, "that the failure of justice in this case was chiefly owing to the jury having been allowed to form their opinion on the surgical treatment pursued" They should have been called upon simply to state whether the prisoner was the man who inflicted the wound, and the judge should then have applied the law as to responsibility for a surgical operation —*Dublin Commissioner's Court, November* 1871.

CASE No XVII —MEDICAL RESPONSIBILITY, MALA PRAXIS

Reg *v.* Dickinson.

IT was ruled, that where there are different modes of treatment, regarding which men of learning are divided, no man can be held to be "grossly ignorant" if he adopts a course sanctioned by some eminent men even though opposed by others —*Stafford Lent Assizes*, 1846 —(*Taylor*.)

CASE No XVIII —ORDINARY SKILL, AND NOT EMINENT SKILL, TO BE EXPECTED.

Gibbs *v* Tunsley.

IT was ruled, that the jury were not to expect the same amount of eminent skill in a country practitioner as is to be met with in large towns; but they had a right to expect from him the usual and ordinary amount of skill, care, and attention, which, it was only reasonable to suppose, he would possess; and if, *in the discharge of his duty*, he applied his professional skill and knowledge to the best of his ability, then, however unfortunate the termination of the case, he was not to be held responsible The case

* The atlas is the uppermost bone of the spinal column, and the bone upon whi head rests

was one for damages, but this ruling would probably apply to the treatment of a wound; and if death followed, even if the treatment could be shown to be not as good as might have been obtained elsewhere, the person who caused the wound, and not the medical man, would be held responsible for the death.*—*Norfolk Lent Assizes*, 1846

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* [illegible]

The two last mentioned cases are important as affording a remarkable contrast to each other.

CHAPTER VI.

CIRCUMSTANTIAL EVIDENCE

The dress—Murder or suicide—Situation of wounds—Nature and extent of a wound—Direction of a wound—Suicide intended to cause suspicion of murder—Circumstances to be noted at the time of finding the body—Marks of blood—Characters of blood stains—Ocular inspection of blood stains—Microscopic demonstration of blood stains—Action of water on blood-stains—Action of heat on blood stains—Action of caustic potash on blood stains—Action of nitric acid on blood stains—Action of guaiacum on blood stains—Hæmin crystals produced by treating blood with glacial acetic acid—Spectroscopic appearances—Menstrual blood—Marks of blood not necessarily found on clothes of murderer

THE evidence treated of in this chapter is what in England is generally to be expected from the medical man called in after the finding of the body or the wounded person In this country the body has generally to be sent to the medical officer, so that the circumstantial evidence, which is often of such importance in the detection of crime, must, for the most part, be gathered by the police and village authorities on the spot

93 The *dress* which the deceased wore at the time of death should be most carefully examined, in order to see whether it presents any marks corresponding with the injuries In this country it often happens that the deceased has worn little or no clothing, but as regards women this is not the case In the case of wounds caused by a cutting instrument, if there is an incised wound on the body, it will be only natural to expect to find a corresponding incision on the clothing In the case of blows from a blunt weapon causing bruises or fractures, this rule does not apply A blow has caused fracture of the skull without leaving any trace on the silk cap which was worn at the time In 1863, a woman was accidentally knocked down in the street and fell on the back of her head She was stunned at first, but walked home Next morning she was found dead in bed The dress

On examination of the skull, two indentations of the parietal bone were found, a clot of blood, and below the clot a fracture of the bone It was considered at first that the injury was too great to have been caused by such a fall, but on examination of the bonnet which she wore at the time of the accident, two indentations, containing dust and dirt, and corresponding with the indentations on the skull, were found on it A young man, who wished to create an impression that he had been attacked by robbers, inflicted some superficial wounds on himself, and afterwards made, as he thought, corresponding incisions in his clothes The imposture was detected owing to his having stabbed through a fold, which he made for the purpose, in his shirt Had he been wearing the shirt at the time, a stab passing *through a fold would make three incisions, two through the* fold and one through the rest of the shirt In this case there were only two

Murder or suicide

94 Much valuable evidence can be gained from a careful examination of the body, which will tend to throw light upon this question The three points to be looked to as regards the wound are,—(1) *its situation*, (2) *its nature* and *extent*, and (3) *its direction*

Situation of wounds.

95 As a general rule, wounds inflicted by suicides are to be found in the front or lateral parts of the body This, however, is no proof one way or the other, since an assassin might have attacked the deceased from the front Even death caused by the discharge of a pistol into the mouth need not necessarily be the act of a suicide, for a calculating murderer might purposely resort to this method of destroying a person in order to conceal the crime On the other hand, Orfila observes that even wounds situated on the back of the body need not necessarily have been inflicted by another person A wound traversing the body from the back to the front, however, is scarcely likely to have been the act of a suicide, although it might be caused by falling backwards on a sword or knife fixed in the ground Take, for instance, the tricks played by jugglers in this country in which they lean backwards over a sword fixed in the ground

and pick up straws with their eyelids In practising this trick, an accident might well occur In a case of this kind some light might be thrown upon the matter by the position of the body when found, whether on the back or on the face, but even this would not be decisive, because the wound may not have caused instantaneous death Suicides rarely cause death by blows, though cases have occurred in which suicides attempted to dash out their brains by striking their heads against a wall Stabs are *generally presumptive of homicide*, but not necessarily proof of it, for suicides have killed themselves by stabs in the throat as well as by stabs in the abdomen

96 A farmer was found dead in the road with his throat cut, i e, the knife had been inserted behind the ear and the throat had been cut outwards, as butchers kill sheep The nature of the wound led to suspicion falling on a butcher, who was afterwards found to have committed the murder Persons labouring under insanity sometimes inflict upon themselves the most extraordinary injuries Cases have occurred in which persons have torn away large portions of the abdomen, and there is one case of a lunatic who inflicted no less than thirty wounds on the back part of his skull with a cleaver He lived long enough to admit that he had caused the injuries himself As a general rule, the existence of a number of wounds is presumptive of homicide, and especially so if several of them in different parts of the body are of such a character that more than one was likely to have caused instant death Thus, a man with a cut throat, some of the large vessels of the neck being severed and a wound in the heart, could scarcely have cut his throat after the wound in the heart, or *vice versâ* A most interesting case, in which the question of murder or suicide was decided *entirely by the nature of the* wounds, is the Uxbridge case (*Reg* v *Gibbons*, Middlesex, 1884) The case was very badly reported in the papers, but the Examining Surgeon, Dr Bowlby, wrote a full report of the whole case to the *British Medical Journal* (January 10, 1885), which has been printed for reference *in extenso* in the Ap-

Nature and extent of a wound

pendix The prisoner was convicted, but owing to a considerable discussion which was raised as to whether the case could not have been one of suicide, the sentence was reduced by the Home Secretary to penal servitude for life. The report of the Examining Surgeon is a marvel of careful observation and analysis Wounds in the throat inflicted by suicides are commonly in the upper part Generally speaking, all the vessels of the neck to the spine could scarcely be severed by a suicide, but there is nevertheless one case on record in which a suicide "divided all the muscles of the neck, the windpipe, and the gullet, had opened the jugular veins and *both* carotid* arteries, and had even grazed the anterior ligaments of the spine" (Taylor)

Direction of a wound

97 In cases of suicide, the direction of the wound is generally from left to right—(with left-handed persons it will be the reverse), and from above downwards, if on the upper part of the body, and from below upwards, if on the lower part of the body. A wound from below upwards, or, in the case of a right-handed person, from right to left, is presumptive of homicide, but not proof thereof A right-handed murderer standing opposite his victim would probably inflict wounds having a direction exactly contrary to that which they would have, if self-inflicted by a right-handed man But if the murderer were standing behind his victim, it stands to reason that he could inflict a wound exactly similar in direction to one the victim himself could cause † As a general rule, it may be said that there is no wound which a suicide inflicts which could not be caused by a murderer, but there may be some wounds, such as those on the back of the body and those with an upward tendency, which, *it is improbable, could be self-inflicted*—improbable, but not, except in very rare cases, impossible.

Suicide intended to cause suspicion of murder

98 It must be remembered that, in the case of suicide,

* The carotid arteries are the large arteries of the neck

† We have heard of an exactly similar case occurring in the experience of a Medical Officer in the Madras Presidency

the deceased may purposely have committed the act under such circumstances as to cause suspicion of murder In England this may be done in order that his family may get the benefit of an insurance policy, and in this country in order to throw suspicion upon a person with whom deceased was at enmity Regarding this point, several interesting cases will be found at the end of the chapter

99 The following points are of the greatest importance, and should be carefully noted by those who conduct the first inspection of the body —(1) Is the position of the body that which a suicide could have assumed? (2) Is the distance of the weapon from the body such as to render it improbable that it could have been placed there by the deceased? Before noting these points careful enquiry should be made as to whether the body has been since moved or the dress in any way disarranged The probabilities are that, in this country, unless the evidence on the first of these points is much more satisfactory than the generality of native evidence, not much importance could be attached to it As regards the latter point, however, it is often possible to get much important evidence If a body is found with a mortal wound, such as throat cut, a stab in the heart, or a fracture of the skull, and the weapon is found at a considerable distance, it is improbable that the act could have been one of suicide If a weapon is found in the hand of the deceased, such as a knife or a pistol, it is most important to notice whether the weapon is grasped firmly or loosely If the former, the case is probably one of suicide, if the latter, of homicide, and the weapon has been subsequently placed in the hand in order to raise a suspicion that the wound was self inflicted At the moment of death there occurs what is called the cadaveric spasm, in which the muscles acquire a sudden rigidity This is quite different from the *rigor mortis*, which does not set in until a considerable time after death If, at the moment of death, a person was holding a weapon in his hand, the effect of this cadaveric spasm would be that the weapon would be tightly grasped and would remain so for several

Circumstances to be noted at the time of finding the body

hours If, however, a murderer placed the weapon in the hand, even though immediately after death, he could only do so by removing the rigidity caused by the spasm, and then, even if the fingers were closed over the weapon, this rigidity could not be restored and the fingers would be limp and pliable

Marks of blood 100 Any marks of blood on the body, the clothing, and in the neighbourhood of the body, should be carefully noted In the case of a person found dead with throat cut, the bloody marks of a left hand were found on the deceased's left arm, thus showing conclusively that the case was one of murder and not of suicide The body of a woman was found dead at the bottom of a flight of stairs with a fracture of the skull The accused, deceased's husband, said that she had accidentally fallen downstairs The fracture was of such a nature that it was probably caused by the fall, but there was also an incised wound in the temporal artery of the body, which, it was improbable, had also been caused in the fall, and at the top of the stairs were found several arterial* spirts of blood on the wall, thus showing that the wound must have been caused at the top of the stairs, and the woman had then either fallen or had been pushed down (*Reg* v *Spicer*, quoted by Taylor) Notice should also be taken of the manner in which the blood has flowed from the wounds If the blood has poured downwards over the body, the wound must have been inflicted when the deceased was in an upright position, if, however, the deceased was wounded when lying down, there may be little or no blood on the body since it may have flowed directly on the ground Wounds on the hands should be carefully looked for, as the presence of wounds of this kind is strongly presumptive that they have been caused whilst the deceased was in the act of defending himself, or in trying to ward off a blow As regards this point and

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* We recognise that an *artery* has been wounded when we see the blood spouting out in jets from the wound and that the blood has a bright red or scarlet color

others of a circumstantial nature, see the interesting case of *Reg* v *Gardner*, at the end of this chapter In the event of a serious wound being found, such as would cause great loss of blood, with, however, but little trace of blood near the corpse, the death has most probably been caused by homicide, and the wound inflicted after death, which had been caused by some other means, such as strangulation, suffocation,* &c. In examinations of this kind, however, great care should be taken that none of the persons present cause any of the marks which are subsequently found For instance, a person might accidentally step in a pool of blood, and afterwards leave a bloody footprint on the floor, which might possibly be taken to be that of the murderer In the matter of footprints, very great care should be taken in the measurement This should be done with the utmost nicety, and a careful record of the measurement should be kept In the event of a bloody footprint near the body, corresponding with that of an accused, being found, a good plan is to obtain a separate footprint of the accused, and then to compare it with the one found, and, if possible, to produce both at the trial In the same way, when a footprint is found in wet mud, the foot of the suspected party should not be placed in the footprint, but he should be made to make another mark, and the two should then be compared If the accused's foot is placed in the footprint found in wet mud, it is clear that if the new foot is a little larger than the print, the print itself might easily assume the form and shape of the new foot In the case of footprints of this kind, it would probably not be impossible to dig up the mud, and after it has got hardened in the sun, to send it, together with the imprint of the prisoner's foot, to the court which tries the case But it must be remembered that an individual's footsteps vary as he might have been walking, running, or standing at the time

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* *Suffocation* or stifling is a stoppage of the respiration produced in any way except by direct compression on the windpipe or by drowning

Characters of blood stains

101 The following are details of the characters of blood-stains under the several heads —

Ocular inspection of blood stains

(1) Blood-stains on dark-coloured materials, which in daylight might be easily overlooked, may be readily detected by the use of artificial light, as that of a candle brought near the cloth Blood-spots, when recent, are of a bright red colour, if arterial, of a purple hue, if venous—the latter becoming brighter on exposure to the air After the lapse of a few hours, blood stains assume a reddish brown tint, which they maintain for years

Microscopic demonstration of blood stains

(2) With the aid of the microscope, blood may be readily detected by the presence of the characteristic blood cells, but even this means of diagnosis may be rendered impossible, by—

(a) the blood being long effused,

(b) the spot being wetted and then dried,

(c) the blood being mixed with other substances, and

(d) *the spot on the cloth having been much* rubbed, or the cloth washed

Action of water on blood stains

(3) Water has a wonderfully solvent action on blood, the stains rapidly dissolving when the material on which they occur is placed in cold water—a bright red solution being formed Rust is not soluble in water

Action of heat on blood stains.

(4) Blood stains on knives, etc, may be readily removed by heating the metal, when the blood will peel off, at once distinguishing it from rust Should, however, the blood stain on the metal be long exposed to air, spots of rust may be mixed with the blood, when the test will fail The solution of blood obtained in water is coagulated by heat, the colour entirely destroyed, and a flocculent, muddy brown precipitate formed.

(5) The solution of the blood obtained in water is boiled, when a coagulum is formed, soluble in hot caustic potash, the solution so prepared is greenish by transmitted, and red by reflected, light

Action of caustic potash on blood stains

(6) Nitric acid added to a portion of the solution of blood in water produces a whitish-grey precipitate.

Action of nitric acid on blood stains

(7) Tincture of guaiacum produces, in a watery solution of blood, a reddish white precipitate of the resin, but on the addition of an ethereal solution of peroxide of hydrogen, a beautiful blue colour is almost immediately developed This test is so delicate that one drop of blood in six ounces of water may be detected by it, and, according to Dr Taylor, is, with the spectroscope, the only certain method of discovering washed blood Washed stains on colourless cloth may be detected by pouring a drop of the tincture of guaiacum on them, and then adding the peroxide of hydrogen. The tincture of guaiacum should be made from fresh resin, and preserved in the dark The peroxide of hydrogen may be obtained under the name of ozonised ether. Other red colouring matters give a reddish colour to the precipitated resin, but the blue colour does not appear when treated with the peroxide of hydrogen, as above described, except after the lapse of some time, and this at once marks the absence of blood Dr Ogston states that he has obtained the blue colour with the guaiacum and peroxide of hydrogen from sweat stains

Action of guaiacum on blood stains

102 Hæmin crystals are produced by treating a drop of blood, or a watery solution of it, with glacial acetic acid in a watch-glass, and then evaporating the mixture The dried residue now contains the crystals of hæmin, which may then be examined under the microscope The crystals

Hæmin crystals produced by treating blood with glacial acetic acid

are rhomboidal in form, tubular, or "otherwise," of a yellowish, yellowish red, or dirty blood red colour When the stain is old, a minute quantity of table salt should be added to the acetic acid solution of the colouring matter of the blood

Spectroscopic appearances

103 Two dark absorption bands appear in the spectrum, one situated at the junction of the yellow with the green rays, and the other in the middle of green rays of the spec trum These may, however from various causes, be modi fied The spectrum of blood treated with carbonic oxide gas presents two similar bands to those of normal blood, but the red and violet rays are more completely absorbed These bands also do not disappear under the influence of reducing agents, as is the case with normal blood The spectrum of alkanet root in solution of alum is like that of recent blood, but differs in having a third absorption band between the green and the blue In a solution of cochineal and ammonia, one black band obliterates the yellow and orange rays This test requires care and considerable practice at spectrum analysis

Menstrual blood

104 There is no means of detecting menstrual blood from human blood, the result of a wound *(Husband)*

Marks of blood not necessarily found on clothes of murderer

105 It by no means follows that when a murder has been committed marks of blood must necessarily be found on the clothes or the person of the murderer If the wound has been inflicted in front by an assassin standing behind, it is of course obvious that no blood would be found on his clothes Still the fact of the prisoner's clothes not being marked with blood, has been on more than one occa sion, urged as a proof of his innocence This was one of the pleas on behalf of Muller, who murdered Mr Briggs, by *first of all violently assaulting him with a life preserver,* and then throwing him from the railway carriage It will, of course, be of importance if it can be shown that the accused washed himself or his clothes soon after the time of the murder In the event of stains being found on a cloth or an instrument, it should not at once be concluded

that they are marks of blood, they may be iron rust, paint or fruit stains, or in this country, betel juice The clothes or weapon should be most carefully packed and sent to the hospital for chemical examination Hitherto it has not been possible for the chemical examiner or medical officer to say more than that the signs are those of mammalian blood, for no method was known of distinguishing between human blood and that of animals The research recently carried out by Dr Monckton Copeman points to the possibility of distinguishing human blood by testing under the microscope for the crystallisation of Hæmoglobin* (see Report of the Chemical Examiner, Madras Dr VanGeyzel, etc, etc, for 1890) Marks of injury on the suspected party should be carefully looked for, and, if found, noted at the time of arrest A remarkable case in illustration of this point occurred in 1834, when the victim of a robbery was able to catch one of the robber's fingers between his teeth and to bite off the end between the nail and the joint The piece of finger was preserved in spirits, and led to the conviction of the robber

* *Hæmoglobin* is the substance to which the red colour of the blood is due; it is the chief constituent of the red blood cells

ILLUSTRATIVE CASES.

CASE No XIX —SITUATION OF WOUNDS

Reg v Wallis

A MAN was charged with killing his wife The body was found on the ground by the side of the bed There were distinct and severe bruises found on the back of the head and on the temples In defence, it was urged that the injuries had been caused by the woman tumbling out of bed This might have accounted for the injuries either at the back of the head or on the temples, but not for both —*C C C*, 1839

CASE No XX —SUICIDE OR MURDER

IN 1837, the body of a woman was found with the throat cut The deceased when found, was lying on her back, and the razor with which the wound was inflicted was found under the left shoulder On inquiry it was ascertained that, when first seen, she was lying on her face and the body had been turned round on the back Blood had evidently run down the fore part of her person, rendering it probable that she had been wounded whilst in an erect position The wound extended from the *right* side of the chin to within an inch of the left collar bone, it had divided the windpipe, the gullet all the muscles of that side and the fore part of the neck, the carotid artery, the jugular vein and the muscles of the fore part of the neck The incision was double—one superficial, close under the chin, and the other, a deeper one, appeared to be continued from this The cut was four and a half inches long and two and a half deep It was held and Taylor says correctly, that the wound was inflicted by another and not by deceased Deceased was right handed which would have added to the difficulty, supposing the wound to have been suicidal —*Taylor*, Vol I, p 516

CASE No XXI

IN 1860, a somewhat similar case occurred The wound commenced on the left side and continued to an inch and a half from the centre of the chin Almost all the organs on that side were more or less affected In the left hand of the deceased was found a common dinner knife, *loosely held* in a reversed position with the back towards the throat There were three incised wounds on the back of the left hand The deceased was right handed It was held to be homicide A fellow servant was suspected, tried, and convicted, on his own confession It is remarkable in this case that the clothes he had on at the time of the murder showed no traces of blood, except a few small spots on the shirt —*Taylor*, Vol I, p 517

CASE No XXII

Reg v Gardner

THIS case presents so many points of interest and importance that a full account of it is necessary In it is to be found almost every point referred

to in this chapter The whole case turned upon the medical evidence Gardner was a chimney sweep, and lived in a small house, of which the other inmates were his wife and a young woman named Humbler It was alleged at the trial that the prisoner and Humbler were on terms of intimacy but this was not proved The wife was found dead in her bed room about 8 A M with her throat cut It was either a case of suicide or else of murder If it was murder, it could only have been committed by her husband or by the woman Humbler, who were the only two other residents It was proved that about 4 A M the husband went out to work, and did not return until after the body was found dead When the medical man Mr Sequeira was called in, the body was lying in the bed room and *rigor mortis* had already set in as far as the upper limbs were concerned The whole body was cold except the abdomen, and as the woman at the time of death was pregnant, this accounted for the warmth in that part of the body Mr Sequeira held, that when he saw the body at 8 A M, it must have been dead at least four hours In this opinion he was confirmed by another medical witness The woman was found lying on the floor, partly under a bed There was a severe wound in the throat, involving the superior thyroid* artery and other vessels From this about two pints of blood had flowed on each side of the neck on to the floor There was no blood anywhere else on the body It was, therefore, clear that the wound in the throat must have been caused when the body was in a recumbent position Death had resulted from suffocation, owing to the blood having flowed into the windpipe In the right hand there was a common table knife, loosely held—the back of the blade towards the palm of the hand and the point of the knife pointing upwards There were four wounds on the inside of one hand and six wounds on the inside of the other The wounds were across the fingers, as if they had grasped the blade of a knife The medical evidence was to the effect that the wound in the throat could not have been caused with the right hand It was, therefore, clear that the woman had been murdered The only two other inmates of the house were her husband, who had left at 4 o'clock, and the woman Humbler The question was which of these two could have committed the crime It was urged in the defence of Gardner that the woman had been killed after 4 A M, the time when he left the house If that had been true, the woman Humbler must have murdered her The medical evidence was, however, conclusive that at 8 A M, when found, the body must have been dead more than four hours, because *rigor mortis* had already set in, and it is clearly proved that in cases of asphyxia† this rigidity does not commence until after six hours This brought the time of death to about 2 A M, when the only person in the room with the deceased was her husband Gardner When the body was found, the room of the woman Humbler was searched, but nothing was found of a suspicious nature Three days

* One of the arteries supplying the thyroid gland This gland is situated across the front of the windpipe, about the middle of the neck

† *Asphyxia* is a term used to express the effects produced by a stoppage of the function of respiration

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to in this chapter The whole case turned upon the medical evidence Gardner was a chimney sweep, and lived in a small house, of which the other inmates were his wife and a young woman named Humbler It was alleged at the trial that the prisoner and Humbler were on terms of intimacy but this was not proved The wife was found dead in her bed room about 8 A M with her throat cut It was either a case of suicide or else of murder If it was murder, it could only have been committed by her husband or by the woman Humbler, who were the only two other residents It was proved that about 4 A M the husband went out to work, and did not return until after the body was found dead When the medical man Mr Sequeira was called in, the body was lying in the bed room and *rigor mortis* had already set in as far as the upper limbs were concerned The whole body was cold except the abdomen, and as the woman at the time of death was pregnant, this accounted for the warmth in that part of the body Mr Sequeira held, that when he saw the body at 8 A M, it must have been dead at least four hours In this opinion he was confirmed by another medical witness The woman was found lying on the floor, partly under a bed There was a severe wound in the throat, involving the superior thyroid* artery and other vessels From this about two pints of blood had flowed on each side of the neck on to the floor There was no blood anywhere else on the body It was, therefore, clear that the wound in the throat must have been caused when the body was in a recumbent position Death had resulted from suffocation, owing to the blood having flowed into the windpipe In the right hand there was a common table knife loosely held—the back of the blade towards the palm of the hand and the point of the knife pointing upwards There were four wounds on the inside of one hand and six wounds on the inside of the other The wounds were across the fingers, as if they had grasped the blade of a knife The medical evidence was to the effect that the wound in the throat could not have been caused with the right hand It was, therefore, clear that the woman had been murdered The only two other inmates of the house were her husband, who had left at 4 o'clock, and the woman Humbler The question was which of these two could have committed the crime It was urged in the defence of Gardner that the woman had been killed after 4 A M, the time when he left the house If that had been true, the woman Humbler must have murdered her The medical evidence was, however, conclusive that at 8 A M, when found, the body must have been dead more than four hours, because *rigor mortis* had already set in, and it is clearly proved that in cases of asphyxia† this rigidity does not commence until after six hours This brought the time of death to about 2 A M, when the only person in the room with the deceased was her husband Gardner When the body was found, the room of the woman Humbler was searched, but nothing was found of a suspicious nature Three days

* One of the arteries supplying the thyroid gland This gland is situated across the front of the windpipe, about the middle of the neck

† *Asphyxia* is a term used to express the effects produced by a stoppage of the function of respiration

ILLUSTRATIVE CASES.

Case No XIX —Situation of wounds

Reg *v* Wallis

A man was charged with killing his wife The body was found on the ground by the side of the bed There were distinct and severe bruises found on the back of the head and on the temples In defence, it was urged that the injuries had been caused by the woman tumbling out of bed This might have accounted for the injuries either at the back of the head or on the temples, but not for both —*C C C*, 1839

Case No XX —Suicide or Murder

In 1837, the body of a woman was found with the throat cut The deceased, when found, was lying on her back, and the razor with which the wound was inflicted was found under the left shoulder On inquiry it was ascertained that, when first seen, she was lying on her face and the body had been turned round on the back. Blood had evidently run down the fore part of her person, rendering it probable that she had been wounded whilst in an erect position The wound extended from the *right* side of the chin to within an inch of the left collar bone, it had divided the windpipe, the gullet, all the muscles of that side and the fore part of the neck, the carotid artery, the jugular vein, and the muscles of the fore part of the neck The incision was double—one superficial, close under the chin, and the other, a deeper one, appeared to be continued from this The cut was four and a half inches long and two and a half deep It was held and Taylor says correctly, that the wound was inflicted by another and not by deceased Deceased was right handed, which would have added to the difficulty, supposing the wound to have been suicidal —*Taylor*, Vol I, p 516

Case No XXI

In 1860, a somewhat similar case occurred The wound commenced on the left side and continued to an inch and a half from the centre of the chin Almost all the organs on that side were more or less affected In the *left hand of the deceased* was found a common dinner knife, *loosely held* in a reversed position with the back towards the throat There were three incised wounds on the back of the left hand The deceased was right handed It was held to be homicide A fellow servant was suspected, tried, and convicted on his own confession It is remarkable in this case that the clothes he had on at the time of the murder showed no traces of blood, except a few small spots on the shirt —*Taylor*, Vol I, p 517

Case No XXII

Reg *v* Gardner

This case presents so many points of interest and importance that a full account of it is necessary. In it is to be found almost every point referred

to in this chapter The whole case turned upon the medical evidence Gardner was a chimney sweep, and lived in a small house, of which the other inmates were his wife and a young woman named Humbler It was alleged at the trial that the prisoner and Humbler were on terms of intimacy but this was not proved The wife was found dead in her bed room about 8 A M with her throat cut It was either a case of suicide or else of murder If it was murder, it could only have been committed by her husband or by the woman Humbler, who were the only two other residents It was proved that about 4 A M the husband went out to work, and did not return until after the body was found dead When the medical man Mr Sequeira, was called in, the body was lying in the bed room and *rigor mortis* had already set in as far as the upper limbs were concerned The whole body was cold except the abdomen, and as the woman at the time of death was pregnant, this accounted for the warmth in that part of the body Mr Sequeira held, that when he saw the body at 8 A M, it must have been dead at least four hours In this opinion he was confirmed by another medical witness The woman was found lying on the floor, partly under a bed There was a severe wound in the throat, involving the superior thyroid* artery and other vessels From this about two pints of blood had flowed on each side of the neck on to the floor There was no blood anywhere else on the body It was, therefore, clear that the wound in the throat must have been caused when the body was in a recumbent position Death had resulted from suffocation, owing to the blood having flowed into the windpipe In the right hand there was a common table knife, loosely held—the back of the blade towards the palm of the hand and the point of the knife pointing upwards There were four wounds on the inside of one hand and six wounds on the inside of the other The wounds were across the fingers, as if they had grasped the blade of a knife The medical evidence was to the effect that the wound in the throat could not have been caused with the right hand It was, therefore, clear that the woman had been murdered The only two other inmates of the house were her husband, who had left at 4 o'clock, and the woman Humbler The question was which of these two could have committed the crime It was urged in the defence of Gardner that the woman had been killed after 4 A M, the time when he left the house If that had been true, the woman Humbler must have murdered her The medical evidence was, however, conclusive that at 8 A M, when found, the body must have been dead more than four hours, because *rigor mortis* had already set in, and it is clearly proved that in cases of asphyxia† this rigidity does not commence until after six hours This brought the time of death to about 2 A M, when the only person in the room with the deceased was her husband Gardner When the body was found, the room of the woman Humbler was searched, but nothing was found of a suspicious nature Three days

* One of the arteries supplying the thyroid gland This gland is situated across the front of the windpipe, about the middle of the neck

† *Asphyxia* is a term used to express the effects produced by a stoppage of the function of respiration

afterwards, however, the man Gardner pointed out some blood which had evidently been lately smeared. It was sworn that this blood had not been there at the time of the first search. The woman was acquitted, but Gardner was convicted, the capital sentence being reduced to transportation for life. It will be noticed that the whole of the evidence in this case was circumstantial, and it was entirely due to the great care which Mr Sequeira had taken in noting every circumstance at the time he was called in that this crime was detected. This was one of the first criminal cases that Mr Gribble heard tried, but he has never forgotten the calm possessed way in which the medical evidence was given.—*C. C. O.*, 1862.

Case No. XXIII.—Self inflicted wounds.

The case of Bolam (Newcastle, 1839) is a leading one on this point. The prisoner was found lying in an apartment which had been set on fire, and near him was the body of the deceased who had evidently been killed with violence, the skull having been extensively fractured by a poker lying near. The prisoner, when found, was either insensible or pretended to be so. He said that he had been suddenly attacked by a man and knocked down by a blow on the right temple. He then felt a knife at his throat. His hands were not cut. He said he received other blows and then became insensible. There was a small wound on the left side of the neck. This wound had merely penetrated the *true skin*,* and there was only a very small effusion of blood from it. There were many cuts in the coat, waistcoat, and shirt, but no corresponding cuts or stabs in the body. The medical evidence was to the effect that the wound was self inflicted, and on this evidence, in the absence of any proved motive for the crime, the prisoner was convicted.

Case No. XXIV.—Self inflicted wounds.

Dr. Chevers quotes several cases of self inflicted wounds. The following may serve as an example.—Three native women and two children were found lying dead in a heap with their throats cut. The husband of one of the females gave the alarm, stating that the crime had been committed by dacoits, who had also wounded and bound him. The wounds on this man were very slight. He said he had been cut at with swords, but the *only wounds found* were two small *parallel* ones on the inside of the *left* thigh. One was scarcely more than a scratch, and the other had only just penetrated the true skin. He had clearly, first of all, inflicted the scratch, and then seeing that this would not be enough, inflicted a little deeper wound in the same place. The man was convicted. Dr. Hutchison says that a made-up sword or knife wound can always be recognized by a tailing, owing to the weapon being drawn across the skin. Except in the case of cut throat, a wound caused by a blow will not show these signs, and

* The skin is composed of a superficial and a deep layer, the *superficial* is called the cuticle or scarf skin, and is that part which is raised by a blister or when very hot water falls on the skin. The deep layer is called also the *cutis vera* or "true skin," and consists of blood vessels and nerves bound together by an elastic and fibre like tissue.

will be deeper than a wound caused by drawing the weapon —*Niz Udalut, N. W P*, 25 *h February* 1853

Case No XXV —Self inflicted wounds

Mr. Percival, who had been a police superintendent, stated, that when he was connected with the police in Bombay, there were two or three gangs in that city who cut and wounded each other for purposes of false accusation and extortion They used to cut one another s necks and arms by turns, as the lot fell, and accuse some rich passer by of having done it The wounded rascal would call out ' murder," and his companions would follow and point out to the police the abode of the alleged culprit, the others declaring that they had witnessed the offence Several respectable persons were thus disgraced and ruined At last it fell to the lot of a youthful member of one of these gangs to have his neck cut The person appointed to cut him was a drunken barber, who, instead of making a slight cut, inflicted a mortal wound The gang fled, abandoning the youth, whose dying confession led to their arrest —(*Chevers*, 358)*

Case No XXVII —Cadaveric Spasm.

An interesting case of this kind occurred in Bordeaux A father and son, after dining heartily together, went to the room in which both their beds were The son lay down on his bed and went to sleep He said afterwards that he was roused by the sound of a pistol His father was then found sitting by his bed, with one arm on the bolster, the other was resting on the inside of the leg and held a discharged pistol The brains had been blown out Suspicion at first fell on the son, because the hand still grasped the pistol, and in experiments made by lifting the arm to the head and then allowing it to drop to the position in which it was found, the pistol dropped out of the hand This very fact, however, established the son's innocence In the experiments tried after death, the rigidity produced by the cadaveric† spasm had been destroyed, and therefore the weight of the pistol caused it to fall from the hand, but when death occurred the cadaveric spasm would have the effect of suddenly tightening the muscles of the fingers, and thus preventing the pistol from falling. It therefore followed that the deceased, when death occurred, must have been holding the pistol in his hand, and it could not have been placed there after death ‡

* For other cases of this kind refer to Chevers, p 357

† *Cadaveric* means pertaining to a corpse or the changes in the body produced by death *Cadaveric spasm* may be defined as a cadaveric rigidity or *rigor mortis* of instantaneous occurrence

‡ For other cases of cadaveric spasm, see Tidy, Vol I, p 64; Taylor Vol I p 70, Case of Lord William Russell, (ibid 65, 66), Case of Robert Reid Edinburgh 1855 Taylor, p 70, See also Ogston, p 377

CHAPTER VII.

PROGRESS OF DECOMPOSITION AND INFERENCE REGARDING THE TIME OF DEATH.

Importance of question regarding how long body has been dead—Decomposition—Period in which body cools—*Rigor mortis*—Cadaveric rigidity—Duration of cadaveric rigidity—Commencement of cadaveric rigidity—Four stages of decomposition—First stage of decomposition—Second stage of decomposition—Third stage of decomposition—Fourth stage of decomposition—Internal warmth preserved after rigidity—Hypostases—Hypostasis occurs before putrefaction—Difference between vital and *post mortem* ecchymosis—Changes produced by putrefaction—Mistaken appearance of poisoning *by mineral acids—Melanosis mistaken for effect of sulphuric or* oxalic acid or caustic alkalies—Ulcerations of stomach and intestines—Softening and perforation of stomach—Putrefaction causes change in colour of skin—Period of discoloration—Fat bodies putrefy sooner than thin bodies—Circumstances which promote and retard putrefaction—Period of appearance of vesications—Period of appearance of immature maggots or the ova of flies—Period of appearance of mature or moving maggots shorter in India than in England.

Importance of question regarding how long body has been dead. AS will be seen from the case of *Gardner*, quoted in the last chapter, the question of how long a body has been dead may be of the utmost importance Upon the correct answer to the question, the life or death of the accused may depend Before putrefaction sets in, a dead body has to go through certain stages There is the cadaveric spasm at the time of death, then follows the gradual cooling of the body; then the *rigor mortis*, and then decomposition sets in.

Decomposition. 106 Decomposition almost always commences in certain portions of the body, and others again only begin to decompose after every other portion has been attacked Decomposition depends, to a great extent, upon the temperature, and therefore the rules laid down in Europe, regarding the time when the several stages occur, will not correctly apply to this country, where decomposition sets in earlier But in this country, as in Europe, the same successive stages have to be gone through before the last stage

of decomposition is reached, and the medical witness can therefore generally tell the probable period during which a body has been dead within 24 hours after death has occurred

107 Taylor says, that in one hundred cases observed by Wilks and himself, there was not an instance in which the body had cooled and rigidity had set in within 4 hours It is rarely that a body cools in so short a time as 6 hours, and in cases of asphyxia, as much as 8 hours is generally required for this process — Period in which body cools

108 Brown Séquard states, that in the bodies of healthy persons, decapitated or asphyxiated, cadaveric rigidity did not appear sooner than 10 or 12 hours after death A remarkable instance of the correctness with which such inferences may be made, occurred in the case of *Jessie McPherson* (Glasgow, 1862)—*Reg* v *McLachlan* The body was first seen by Dr Macleod on the night of the 17th July, *i e*, in midsummer, when the mean temperature of the air was 50° F "The *rigor mortis* was present in all the articulations,* but it was then departing The body was perfectly cold, even on the abdomen and at the flexures of the joints There were no signs of decomposition, and the temperature was unusually cool By 10 A M on the next day, *rigor mortis* had disappeared from all the joints, except the knees and the ankles Death had resulted from violence and from profuse hæmorrhage The victim was free from disease *Rigor mortis* sets in generally from 10 hours to 3 days after death When, however death has been sudden, and is due to violence, it sets in more slowly, and Macleod therefore considered that in this case, at least, 48 hours must have elapsed from the time of death until the rigidity set in But when the *rigor mortis* sets in slowly, it lasts all the longer and *vice versâ*, the average period of disappearance being from 24 to 36 hours He, therefore, considered that in this case the rigidity must have lasted 30 hours, and, putting these figures together (48 and 30), — Rigor mortis

* Or joints

he arrived at the conclusion that about 3 days had elapsed since death The evidence subsequently recorded proved, as nearly as could be, that *this was the time which had passed* between death and the examination of the body"—(Taylor, 3rd ed, Vol I, p 85)

Cadaveric rigidity

109 With regard to cadaveric rigidity, "Taylor says this condition in bodies in Europe begins in from 5 hours to 6 hours after death Casper says that cadaveric rigidity may come on at any period after death, during a tolerably wide interval of time, in general however between 8, 10, and 20 hours, and may continue much longer than is usually supposed, that is, from 1 to 9 days, while in Bengal the latest period of its commencement during the rains was 7 hours, and in October 20 hours and 30 minutes The shortest period was 40 minutes in the rainy season and 25 minutes in October"

Duration of cadaveric rigidity

110 On the duration of cadaveric rigidity, Dr MacKenzie remarks that the longest period of the duration of cadaveric rigidity was 40 hours while the shortest period was 3 hours, whereas the average period was 19 hours and 12 minutes In 3 cases it occurred in less than 5 hours, in 6 cases from 5 to 10 hours, in 3 cases from 10 to 15 hours, in 6 cases from 15 to 20 hours, in 14 cases from 20 to 30 hours, and in 4 cases from 30 to 40 hours

Commencement of cadaveric rigidity

111 The time of commencement of cadaveric rigidity varies Of 36 cases the latest period of the commencement of cadaveric rigidity was 7 hours The earliest period was 40 minutes The average period was 1 hour and 56 minutes In 6 cases it commenced in from 30 minutes to 1 hour, in 19 cases from 1 to 2 hours, in 5 cases from 2 to 3 hours, in 2 cases from 3 to 4 hours, in 3 cases from 5 to 7 hours, and in 1 case it had commenced before observation

Four stages of decomposition

112 Taylor gives four stages through which a dead body passes, with the average duration of each stage The periods given have been tested with the experience gained

in this country, and they are therefore now detailed with such modifications as have been considered necessary :—

(a) *First stage*.—This is characterized by the warmth of the body being more or less preserved, and by a general or partial relaxation of the voluntary muscles. During this period the muscles are capable of contracting when stimulated. After considering the various circumstances, such as temperature, clothing, and disease, which may have retarded or accelerated the cooling of the body, it may be inferred that death has taken place from a few minutes to three or more hours previously. First stage of decomposition.

(b) *Second stage.—In this the body is perfectly* cold* throughout, and the cadaveric rigidity is well marked. The muscles are no longer susceptible of contracting under galvanic or mechanical *stimuli*. In such a case death may have occurred from less than 2 hours to 24 hours (three days in cold climates) previously. Naked or scantily covered bodies may become cold externally and rigid in a very short time. Madras *post-mortem* records show that rigidity is commonly present in bodies which have been 2 or 3 hours dead. Second stage of decomposition.

(c) *Third stage*.—Cadaveric rigidity has disappeared. This stage may last for some hours—longer in cold climates. Third stage of decomposition.

(d) *Fourth stage*.—Putrefaction begins, a slight bluish-green discolouration of the skin of the abdomen being usually its first indication. In Madras *this stage ordinarily begins about 20 hours after* death. Fourth stage of decomposition.

113. It must be borne in mind that there is no very clear Internal warmth preserved after rigidity.

* A general exception to this rule obtains during the hot weather in India, when the average atmospheric temperature exceeds 90° Fahr. in the shade.

line of demarcation between these periods For instance, we may have internal warmth preserved after rigidity has occurred In other cases putrefaction sets in very soon after death In some cases of death from gun shot injury, rigidity occurs almost immediately after death The above periods, therefore, can only be taken to afford approximate indications of the time of death in ordinary cases

Hypostasis

114 There are changes which take place in a dead body, the signs of which if not carefully noted are calculated to create a false impression of violence These changes come on during the act of cooling, and are termed cadaveric rigidity and hypostasis At a later period dark livid patches appear on the skin, which are called sugillation or *post mortem ecchymosis* These appearances have occasionally given rise to serious mistakes being committed, owing to a suspicion of violence being raised Christison refers to two cases, in one of which two persons were convicted, and in the other, three narrowly escaped conviction (see Illustrative Cases Nos XXIX and XXX) * The causes of these appearances are thus described by Taylor, page 89

Hypostasis occurs before putrefaction

115 The first form, *hypostasis* occurs before putrefaction, and is dependent on a stagnation of blood in the capillary† vessels When after death the capillaries have lost their contractility, the blood appears to stagnate in them in an irregular manner, producing lividity The skin of the body, although pale at the time of death, becomes covered, during the act of cooling, by extensive patches of a bluish or slate colour, diffusing themselves over the greater part of the trunk and limbs These hypostases are chiefly seen on the bodies of those who have died suddenly in full health or by a violent death, as in apoplexy, hanging, drowning, suffocation from charcoal vapour, &c, but it may be seen,

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* See also Reg v Ker Aberdeen quoted by Taylor 3rd ed p 88

† *Capillaries* are the minute ramifications or branches of blood vessels terminating on the surface of the body in the substance of solid organs or internal cavities They are situated between the arteries and veins, and connect these with each other

though to a less marked extent, in the bodies of those who have died from loss of blood. If, after death, the body is wrapped up in a cloth and allowed to cool, the congestion* of the vessels is apt to take the form of the folds, and the parts actually compressed remain white. The result is an appearance of stripes as from a flogging. "The unbroken state of the cuticle, with the other characters just now mentioned, are, however, sufficient to distinguish this appearance from the effects of violence." Dr Taylor saw a well marked case in which so strong a suspicion was raised that a coroner's inquest was held. "The forepart of the body was covered with stripes, which were of a red livid colour. They appeared to correspond exactly to the folds of a sheet drawn tightly across the chest, and it was subsequently ascertained that the body of the deceased had been treated in this manner after death." One case (see Illustrative Case No. XXXI) is quoted, in which symptoms were seen which ordinarily are only to be found in vital ecchymosis. Around the patches was a wide border of a pale straw colour, with various shades of green, precisely similar to those which are seen when ecchymosis is gradually disappearing from the living body.

Table showing the points of difference between a vital ecchymosis (bruise) and a post-mortem ecchymosis (lividity) †

Difference between vital & post mortem ecchymosis

Vital ecchymosis	*Post mortem ecchymosis*
1 *Anatomical seat.*—Effusion of blood from small ruptured vessels into the true skin and the surrounding cellular or areolar tissue (subcutaneous tissue)	1 *Anatomical seat.*—Congested capillaries in the rete mucosum and vascular tissue *above* the true skin
2 *Position.*—The seat of the injury	2 *Position.*—Such dependent parts of the body (according to how it may be placed) as are not subjected to pressure
3 *Appearance.*—The bruise *will often be noted to have the* shape of the instrument that inflicted the injury. Its colour not generally uniform. The bruised part is often elevated above the surrounding skin	3 *Appearance.*—Irregular in *shape but with well defined edges*. The colour uniformly dark. Not elevated above the skin

* Congestion is the abnormal collection of blood in a part or organ

† From Lyon's *Legal Medicine* Part I, pp 78—79

4. *Extent.*—More or less limited to the parts injured.	4. *Extent.*—At first the stain appears in isolated patches, rapidly running together more or less over the whole of the dependent portions, except those parts subjected to the pressure of the surface on which the body rests.
5. *Results of incision.*—Effused blood at once flows from the cut.	5. *Results of incision.*—No effused or coagulated blood escapes, although perhaps a few bloody points (*puncta cruenta*) where the veins have been divided may be apparent.
6. *Changes by time.*—The dark purple bruise after 18 to 20 hours, or sometimes as late as 2 or 3 days, becomes highly tinted at the edges and of a more or less violet colour. After this the colour of the bruise passes through various shades of green, yellow and lemon, the centre however always being the darkest part. During these changes which are dependent on the oxidation of the effused blood, the spot enlarges. The changes are complete in times varying from a few days to some weeks.	6. *Changes by time.*—The colour remains tolerably constant until putrefaction sets in. No zones of colour form round the edge, such as occur in a life bruise.*

Changes produced by putrefaction.

116. During the stages which the body goes through in the course of putrefaction, there are changes which take place in the viscera or internal organs, which, if not carefully examined, may give rise to a suspicion of death from an irritant poison. Regarding these changes Taylor says: "The mucous membrane† of the stomach may be found of various tints—from a red brown, becoming of a brighter red by exposure to the air, to a deep livid purple or slate colour, and sometimes black from a decomposition of the blood. At the greater end, where the stomach is in

* [illegible]

† The mucous membrane is the internal coat of the stomach walls.

contact with the spleen or liver, the lividity is often well marked and clearly defined through all the coats The peritoneal, or outer coat, is of a greenish hue, and the course of the superficial vessels is marked by greenish brown or black lines These marks, which are the result of putrefaction, may be easily mistaken *for the effects of* irritant poisoning There are no rules that will always enable a medical jurist to distinguish such cases" Each case must be judged by its own attendant circumstances Of course, if symptoms of this kind were found *before* decomposition had set in, they could not be due to that cause, and would probably be due to poison In cases of doubt, "it is therefore better to withhold an opinion," than to state what can be really nothing more than a conjecture

117 In the same way the mucous membrane of the stomach and upper part of the small intestines often present, during putrefaction, a yellowish or green tinge, depending on the transudation of the bile or the colouring matter of the fæces contained in the colon This must not be mistaken for the appearance of poisoning by mineral acids The medical man who examined the body should be asked whether there was also any softening or corrosion, and whether the throat and the gullet were also implicated If these signs are absent, the symptoms have not been produced by such poisons

Mistaken appearance of poisoning by mineral acids

118 So also melanosis in the stomach, *i e*, a deposit of black colouring matter beneath the mucous coat, might be mistaken for the effect of sulphuric or oxalic acid, or caustic alkalies, but as melanosis is unaccompanied by any marks of inflammation, corrosion, or destruction in the mucous membrane beneath, it should be easily distinguished from the effects produced by such poisons

Melanosis mistaken for effect of sulphuric or oxalic acid or caustic alkalies

119 Ulcerations of the mucous membrane of the stomach and the intestines are common in India, and should not be confounded with putrefactive changes, but it may not always be easy to distinguish them from erosions due to irritant poisons

Ulcerations of stomach and intestines

Softening and perforation of stomach

120 Softening, and even perforation, of the stomach, occasionally results from the action of the gastric juice* exerted after death Dr Helur has seen several such cases In these cases the softening is gelatinous, and is not accompanied by signs of inflammation, such as redness at the margins of the softened patch and peritonitis †

Putrefaction causes change in colour of skin

121 As putrefaction commences, a change in the colour of the skin of the abdomen takes place, which acquires a pale green hue, gradually deepening and extending to the skin of the chest and the limbs This is different from the hypostasis already alluded to, because that change only takesplace whilst the body still retains some warmth, and directly the body becomes cold it is arrested The change now spoken *of occurs after the body has become cold and* when decomposition has commenced

Period of discoloration

122 Regarding the period of appearance of green discoloration, Dr McKenzie says —"The latest period at which the green discoloration of putrefaction appeared was 41 hours and 30 minutes, the earliest period was 7 hours and 10 minutes, and the average period was 26 hours and 4 minutes In two cases it occurred under 10 hours, in four cases from 10 to 20 hours, in 18 cases from 20 to 30 hours, in 10 cases upwards of 30 hours, and in 2 cases it was not observed at all"

Fat bodies putrefy sooner than thin bodies

123 Fat flabby bodies undergo putrefaction more readily than thin and emaciated ones, and, as already pointed out, the parts which have sustained injuries—such as wounds, lacerations, or bruises—commence to decompose first and then show exaggerations of the actual injuries inflicted Again, bodies of persons who have died from acute diseases commence to putrefy before those who have died of wasting and chronic disease

* The *gastric juice* is the fluid secreted by the small tubular glands of the stomach

† *Peritonitis* is inflammation of the peritoneum The peritoneum is the serous or thin membrane investing the inner walls and organs of the abdomen

3 *Air.*—If blood or flesh be placed in a vacuum its decomposition proceeds slowly.

Similarly, decomposition is slow in atmospheres of hydrogen, of nitrogen, or of carbonic anhydride, or indeed of common air, provided vapour (such as turpentine) be present, capable of absorbing oxygen Air also promotes decomposition as a carrier to the body of the lower forms of organic life, which themselves have the power to start, or at any rate to promote, chemical changes

A body putrefies more rapidly in air than in water or after burial Given similar temperatures, the degree of putrefaction developed in a body during one week's exposure to air will about correspond to that developed after submersion for a fortnight, or after burial in a deep grave for a period of eight weeks

A naked body putrefies more rapidly than a clothed one Decomposition will be less rapid in parts where the clothes fit tightly (*e g*, in the feet with boots on), or if the clothes worn be impermeable to air

In a leaden coffin, putrefaction is slow from the oxygen soon becoming exhausted Thus, in the case of bodies buried in lead, the faces may be recognisable after the lapse of long periods of time

3 *Air.*—If access of air to a body be prevented by any means, such as by its enclosure in a close coffin, by tightly fitting clothes, or by complete immersion in water, putrefaction is retarded.

4 *Combined action of warmth, moisture, and air*—It is important to consider the action of these jointly as well as separately:—

Moist air promotes putrefaction

Stagnant air promotes putrefaction.

A moist cold air in winter assists putrefaction more efficiently than a dry hot air in summer.

A moist, hot, stagnant air is the most favourable atmospheric condition for putrefaction.

4 *Combined action of warmth, moisture, and air.*—Dry air retards putrefaction.

Air in motion retards putrefaction.

A dry hot air in summer retards putrefaction more efficiently than a moist cold air in winter

A dry cold air in rapid motion is the least favourable atmospheric condition for putrefaction.

The removal of moisture from the body by whatever augments evaporation (as *e g*, by warmth,

Thus of the three (air warmth and moisture) the presence of moisture is a more important means of promoting putrefaction than either warmth or air

5 *Effects of Burial* —Putrefaction is promoted by—

(*a*) The body having been kept for a long time exposed to the air before interment Besides the mere action of oxygen, insects, during exposure, may find their way to the corpse and deposit their ova in or upon it These when hatched, materially assist putrefaction

(*b*) The grave being situated in low ground (as in a valley) and in a damp swampy soil

(*c*) The body being buried without clothes or coffin Thus, where infants (as not infrequently happens) have been merely thrown into the ground, and loosely covered over with earth, putrefaction is rapid.

(*d*) Burial in a shallow grave, where the body is exposed to constant variations of temperature The

free atmospheric currents, etc.) constitutes the most important means of retarding putrefaction

5 *Effects of Burial* —Putrefaction is retarded by—

(*a*) Burial within a short time after death

(*b*) The grave being on high ground and in a dry absorbent soil Thus, bodies buried in dry, warm sand often become mummified, in which condition they resist putrefaction almost indefinitely.

(*c*) The body being well wrapped in its shroud and enclosed in a well secured coffin lead coffins being undoubtedly the most perfect in this respect The oxygen present in such case is rapidly exhausted, whilst the remaining nitrogen is somewhat antiseptic in its action Oak coffins are also very durable and efficient, but those made of deal or pine soon rot and fall to pieces. Burial in water delays putrefaction so far as it prevents access of air Burial in peat delays putrefactive changes in a remarkable manner.

(*d*) Burial in a deep grave The deeper the grave the more perfect the retardation, because the body

diurnal changes extend to about three feet below ground, and the monthly or seasonal changes to nearly six feet. Thus, putrefaction is more rapid when a body is buried in six feet (or less) of earth than when interred in a deep grave.	is placed beyond the daily and seasonal changes of temperature. At a depth of six feet the temperature of the ground is low and fairly uniform.
(*e*) Burial in marl or clay (if air have access), or in loose mould, or in porous soil impregnated with animal and vegetable matters.	(*e*) Burial in sand, gravel, or chalk.
[It is possible, under these conditions, if the grave be not too dry, that adipocere may be *formed when putrefaction is suspended.*]	[In such cases adipocere is rarely formed unless water finds its way into the grave.]
6. *Age and sex.*—Childhood. According to Orfila, putrefaction is rapid in the female.	6. *Age and sex.*—Adults and old age. Males are said to decompose less rapidly than females.
7. *Cause of death.*—Acute exhausting diseases such as hydrophobia, typhus and typhoid, dropsy from organic disease, a diseased state of blood (pyæmia), delivery, etc., promote putrefaction.	7. *Cause of death.*—Thus putrefaction is delayed after death from chronic diseases (Case 31c) unless they be associated with dropsy. In the case of plethoric persons who have died suddenly in good health, and after death by asphyxia, putrefaction is usually slow in appearing.
8. *Corpulence.*	8. *Leanness.*
9. *Certain poisons.*—It is said that putrefaction is rapid after death by prussic acid, morphia and narcotic poisons generally (Casper), also after death from certain animal and gaseous poisons, such as CO (carbon monoxide) and H_2S (sulphureted hydrogen). The bodies of the intemperate putrefy rapidly. [N. B.—In this case, the true question, no doubt, is not so much the action of the poison as the question whether the patient was so exhausted by fatigue or pain before death that rigidity supervened rapidly?]	9. *Certain poisons.*—Arsenic, antimony, chloride of zinc, also chloroform, phosphorus, and strychnia, when they are actually the cause of death, usually retard decomposition. In arsenical poisoning, putrefaction ordinarily commences as usual, but seems to stop after it has commenced. Then a process very similar to mummification begins. After death by sulphuric acid and other mineral acids putrefaction appears to be retarded, possibly from the acid preventing the formation of ammonia or combining with it as soon as formed.

10 Any parts affected by bruises, fractures, or wounds putrefy rapidly. Such portions of the body look worse a few hours after than before death. Putrefaction is specially rapid in parts that have been subjected to surgical operation.

11 Lime, if freely applied to a dead body, may retard putrefaction by preventing access of air. In smaller quantities, however, it acts both as a deodorizer and antiseptic. The attempts, not uncommonly made to destroy a body by covering it with lime, usually on the contrary succeed in preserving it. In tanning skins, the application of lime is adopted for the purpose of removing the fat and separating the hair. Possibly a little external softening of the article may be thereby effected, but no change results so far as the tissues generally are concerned, the fact being that lime prevents putrefaction (and even arrests its progress if already started) by changing the skin into a hard and dry substance.

12 *Mineral acids.*—By such means putrefaction is retarded by the destruction of the tissues.

13 Various antiseptics.*

125 Concerning the period of appearance of vesications on the surface of the body, we make the following extract from Dr MacKenzie's book —"The latest period of the appearance of vesications on the surface of the body was 72 hours, the earliest period was 35 hours, and the average period was 49 hours and 39 minutes. In 17 cases it occurred in from 35 hours to 48 hours, in 10 cases from 48 to 60 hours, in 5 cases from 60 to 72 hours, and in 4 cases it was not observed at all." Period of appearance of vesications

* TIDY'S *Legal Medicine*, Vol. I, p. 88 *et seq.*

Period of appearance of immature maggots or the ova of flies

126 The latest period at which immature maggots appeared was 41 hours and 30 minutes, the earliest period was 3 hours and 20 minutes, and the average period was 25 hours and 57 minutes In 2 cases it occurred in less than 10 hours, in 5 cases from 10 to 20 hours, in 11 cases from 20 to 30 hours, in 5 cases upwards of 30 hours, and in 13 cases it was not observable, as the deposit took place in the internal cavities, the mouth, nostrils, etc

Period of appearance of mature or moving maggots shorter in India than in England

127 The period of appearance of the mature or moving maggots is much shorter in India than in Europe "The latest period of the appearance of the mature or moving maggots was 76 hours, the earliest period was 24 hours and 18 minutes, and the average period was 39 hours and 43 minutes In 6 cases it occurred in from 34 hours and 18 minutes to 30 hours, in 16 cases from 30 to 48 hours, in 11 cases from 48 to 72 hours, in 1 case upward of 72 hours, and in 2 cases it was not observed "*

Rate of putrefaction

128 Guy gives the following rate of putrefaction in the internal organs —In from four to six days after death, dirty red patches appear on the posterior wall of the *stomach* and gradually extend over the whole interior These changes are sometimes mistaken for the effects of corrosive poison The *intestines* follow next and then the *spleen*, then the *liver*, which, however, may retain its firmness for some months, putrefaction commences with a green colour on the diaphragmatic or upper surface The *brain* follows next, it collapses after death, and its putrefaction commences in the line of the blood vessels, and in two to three weeks time the brain becomes quite diffluent The brain of children, however, is the first organ destroyed by putrefaction The *heart* and *lungs* putrefy more slowly, so that traces of disease are distinguishable in them long after they are quite decomposed Orfila detected pneumonia thirty seven, and signs

* MACKENZIE's *Medico legal Experiences in Calcutta*

of pericarditis fifty-seven, days after death The *kidneys* resist putrefaction even longer than the heart and lungs; the *bladder*, the *œsophagus* (or food-pipe), and the *pancreas* (or sweetbread) resist still longer; and the *diaphragm** may be *distinguished even after four to six months.* The *uterus* (or womb) resists putrefaction longest of all, and enables us to distinguish the sex after the complete destruction of all the other soft parts Casper found it at the end of nine months in a fit state for examination, so that he could solve the question, whether the deceased died pregnant, when all the other viscera† were gone and the bones almost separated from one another

129 The period of death, as inferred from the state of decomposition, is often a point of great importance, but the cases quoted are so conflicting, that no safe rules can be laid down as to the exact time which has elapsed since death There are so many different factors which have the effect of accelerating or retarding decomposition, that each case must be judged by its own circumstances, and whenever there is any possibility of doubt, the medical witness should be most careful not to give a decided opinion It is, however, clearly established that decomposition sets in soonest when the body is exposed to the air

Opinion as to time of death from state of putrefaction

130. In buried bodies decomposition is slow in dry sandy soils, as in Egypt, or in gravel and chalk, to which water has no access It is quick in marl or clay, and quicker in proportion as air or water has access to the spot It is slower in deep graves than in shallow ones, and is quicker in bodies buried without any covering, becoming slower in proportion as the coffin is able to resist the air and the surrounding influences of decay As regards water, Dr Chevers gives some notes on the periods when, owing to the generation of gases, bodies rise to the surface in this country The earliest

Decomposition in air, earth, and water

* The *diaphragm* is the muscular partition between the abdominal and thoracic cavities

† The word *viscera* is the plural of viscus The term viscus is applied to any organ or part having an appropriate use.

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period mentioned by Dr. Woodford, at the hottest time of the year, was twenty-four hours. The period of formation and evolution of gases is of some importance. Dr. MacKenzie* says, "this was manifested by the distension of the abdomen, or by the exudation of froth from the mouth and nostrils, or by the expulsion of fœces through the anus" In his 36 cases "the latest period at which gases were evolved was 34 hours 30 minutes, and the earliest period was 5 hours 50 minutes, while the average period was 18 hours 17 minutes In 9 *cases it occurred in from 5* hours 5 minutes to 10 hours, in 10 cases from 10 to 20 hours, in 14 cases from 20 to 30 hours, in 1 case from 30 to 40 hours, and in 2 cases it was not observed at all" In the cases observed during the rains, the latest period at which gases were evolved was 34 hours 30 minutes, the earliest period was 5 hours 50 minutes, and the average period was 18 hours 17 minutes, while in October the latest period *of its appearance was 47 hours, the earliest period was 16* hours 10 minutes, and the average period was 29 hours 17 minutes Casper says that in about eight or ten days the gaseous products of decomposition begin to be developed and to distend the abdomen

Buoyancy of decomposed body in water

131 An interesting case occurred within Mr Gribble's experience A woman was killed on the night of a Friday, and the evidence went to show that the body must have been thrown into a well† about midnight On the following Sunday morning, about meal-time, which was about 8 or 9 A M, the body was found floating with a heavy stone attached to it The woman was said to have been of slight figure and short stature, and therefore probably, when alive, did not weigh more than 100 to 105 lbs The stone itself weighed 92 lbs, so that the decomposition in 30 hours must have been so rapid as to generate gas capable of raising, not only the body itself, but the dead-weight

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* *Medico Legal Experiences in Calcutta*

† A large square well, such as is used for irrigation purposes

attached to it The stone was attached to the waist, and the body, when found, was lying horizontally on the surface of the water on its side The water was from ten to twelve feet in depth, and the specific gravity of the stone was 2 7 This case is of interest, as showing the extreme buoyancy of a decomposed body in water, and the rapidity with which gases can be generated. The murder occurred in September 1883

132 Out of a number of victims of a river accident which occurred in Calcutta in 1867 (January), notes were taken of the time when the bodies came to the surface In none of these cases were any bodies found under three days, and in some cases they did not rise to the surface until six or seven days after the accident As a general rule, bodies in this country, when found in wells of average depth, rise on the third to the fifth day, and then show all signs of decomposition In the accident above alluded to, the four first bodies were recovered three and a half days after death, but no mention is made of any signs of decomposition Dr MacKenzie's experience with regard to the period in which *saponification** takes place is of the utmost importance and interest He says —"During the nine years that I have been considering, in my notes on Medico-legal Examinations in Calcutta, I find I have had 8 cases of saponification, 7 of which are most interesting, as they show that this condition is more readily formed in the human body in the River Hooghly, as well as in the damp soil of Bengal during the rainy season, than in Europe The first of the 8 cases was the body of an adult native female, of about 25 years of age, apparently that of a Mahomedan woman from Behar or the North-West Provinces, found

Notes of a river accident regarding buoyancy of dead bodies

* *Saponification* refers to the combination of an alkaline base with a fatty ... Med co ... nce called ... with the ... It consists ... Human

in the water near the bank of a large tank called Motee Jheel, within the Calcutta race-course, with her throat cut, a portion of the body eaten away by fishes, and apparently having been in the water entangled among the weeds for several days"

ILLUSTRATIVE CASES

Case No XXIX —Hypostasis mistaken for marks of injury

Reg v Keir

A man named Keir and his mother were tried on the Aberdeen Circuit for the murder of the father of the man The prisoners were condemned, but the only evidence of any weight against them was the appearance of a broad blue mark on the fore part of the neck, which the witnesses compared to that produced by strangulation There was, however, great reason to believe, from their own description of it, that it was due to natural changes after death —(*Taylor*, page 89, Vol 1)

Case No XXX —Hypostasis mistaken for marks of injury

Three men left a public house intoxicated and quarrelling with one another On the next morning one of them was found expiring in a wood, and he died soon afterwards Two surgeons deposed that they found the marks of numerous contusions all over the body, and upon this deposition the two companions of the deceased were committed and subsequently tried At the trial, Drs Bell and Fyfe proved, to the satisfaction of the court, that the apparent contusions were nothing else than the livid patches, or hypostases, which sometimes occur spontaneously on the dead body after many kinds of death The accused were acquitted —(*Taylor*, page 88)

It is worthy of remark that hypostasis is frequently noticed in cases where persons have died under the effects of intoxication, and to this cause may, perhaps, be due the symptoms in the case quoted by Beck (*vide* page 51)

Case No XXXI —Hypostasis mistaken for marks of injury

A man died in 1837, in the Dreadnought hospital, of disease of the heart Just before death he had been auscultated,* and there were then no marks on the body Eighteen hours after death the body showed numerous patches, varying in size They greatly resembled bruises, and occurred only in those parts of the body which were not compressed by the position in which it was lying A peculiarity about these marks was that they appeared exactly like vital ecchymoses, with a border of pale straw colour with various shades of green and blue In remarking on this case Taylor says: "Had the body of this person been found lying dead on a high road, and had it been proved that another man had been seen quarrelling with him, what might have been the opinion expressed? We can scarcely hesitate to say, unfavourable to the accused" The hypostases might have been wrongly held to be the marks of blows, and the death from heart

* Examined by means of the stethoscope

disease might have been held to have been brought on by the excitement caused by those blows

CASE No XXXII —EFFECT OF THE GENERATION OF GAS IN DECOMPOSITION

DR CHEVERS quotes a case in which the effect of the gas, generated in a decomposing body, was to eject from the uterus a four months' fœtus, together with the acrid root which had been used for the purpose of procuring abortion Taylor quotes a similar case, in which the gases had sufficient force to expel the fœtus from the uterus when the woman had died during labour and undelivered A similar case was also the subject of a coroner's inquest at Sydney in 1864 *

CASE No XXXIII —DIFFICULTY OF CALCULATING EXACT PERIOD OF DEATH FROM THE STATE OF DECOMPOSITION

THE leading case on this point, quoted by all the medical jurisprudents, is Reg v Byrne,† in which a woman was tried for the murder of her husband (Dublin, 1842) The prisoner and the deceased were in the habit of drinking to excess On this occasion they had retired to their room and had remained in it for eight days Four days before he was found, the husband had been seen alive at the door On the eighth day the prisoner called one of her sons and the body of the husband was found in an advanced stage of decomposition, whilst the prisoner was still in the room The medical witness, who first saw the body, was led to believe that it had been dead, at least, four to five days There were no special marks on the body of injuries except certain discolorations, and internally the heart was empty, and so were the vessels of the brain The body was found on its face During the time they had been together in the room, a large amount of spirits had been consumed. The prisoner made two statements first, that she slept in the bed on Thursday and Friday, and that deceased died on Friday She subsequently stated that he died on Saturday, the day when the body was discovered Two medical witnesses said, deceased must have been dead four to five days, two declined to give an opinion, and one said that such changes might take place in from twenty eight to thirty hours (The month was July, and the room itself was very close) On the one hand, it was argued that the deceased had died from strangulation, judging from some black marks on the neck and the protrusion of one eye and of the tongue, and, on the other, it was argued that these marks were natural, that deceased may have smothered himself whilst in a state of intoxication, by turning his mouth and face on the pillow, or that he might have died in a fit The discoloration of the face, the protrusion of the eye and tongue, and the discharge of fœces might be ac-

* Note —The generation of gas frequently leads to post mortem hæmorrhage and this bleeding is apt to be produced by pressure on an inflated part the gas thus compressed, seeking to escape forces out the blood from the nearest aperture hence the old superstition that a dead body would bleed at the touch of the murderer

† For full report of this case see TIDY s *Legal Medicine*, Vol I p 126

counted for by his dying in a convulsive struggle, or the symptoms of the eye and tongue might be simply due to advanced decomposition (of which there are numerous recorded cases) The emptiness of the heart, which was adverse to the theory of strangulation (asphyxia) was referred to the mechanical effect of gaseous putrefaction on the organ The emptiness of the brain was unexplained No motive was assigned for the murder, and the principal point again st the prisoner was that she must have been in the room at least, twenty hours after the death without calling for assistance The prisoner was acquitted, and Taylor says, " The jury were properly informed by the learned judge (Baron Pennefather) that they were not to convict the prisoner on probability, however strong or on a mere preponderance of medical opinion "—(*Abridged from* TAYLOR *and quoted by* TIDY *and* BECK)*

CASE No. XXXIV —CASE OF A BODY BEING FOUND IN THE SAME HOUSE AS THE MURDERER

THIS was rather a singular case, and was tried in the November sessions at Cuddapah (1883) Prisoner was a Brahmin of dissolute habits, and deceased was an elderly woman One day, about noon, prisoner was seen taking the deceased to his house She did not return After some time the daughter went to the house and enquired after her mother Prisoner told her that she had gone away to a village two miles distant This was found to be untrue The daughter returned in the evening and told this to the village authorities, who went to prisoner's house. Being late, they did not search it, but remained in the house with the prisoner the whole of the night During this time the prisoner was described as if under the influence of drink Next morning the body of deceased was found in an inner room, perfectly naked and covered with several deadly incised wounds The floor and walls showed considerable traces of blood In this case the prisoner had himself given a written statement that he had killed the woman, otherwise it is probable that he would have been acquitted No other motive for this singular murder was given than that the deceased had probably seen a bottle of arrack and some meat in his house, and that he had killed her for fear that she would tell this in the village, and he, being a Brahmin, would lose caste If this was the real motive, prisoner was at the time of the murder probably intoxicated He was convicted and hanged, and is said, before execution, to have confessed to the police There was a great deal of popular indignation against this man, especially amongst the Brahmins of the town, numbers of whom came to see his execution

* See also Reg v Mahaig (TIDY's *Legal Medicine*, Vol I, p 129)

CHAPTER VIII.

WOUNDS, RUPTURES, AND OTHER INJURIES AS AFFECTING DIFFERENT PARTS OF THE BODY.

Wounds of the head—Difference between concussion of the brain and intoxication—Fractures of the skull—Wounds on the face—Injuries to the spine—Incised wounds to the chest—Torture by *Bans lola*—Confessions obtained by police—Confessions made to police inadmissible as evidence—Ordinary occurrence in evidence of police officers—Extortion of confessions—Pressure on the chest as a means of extorting confessions—Cases of sudden death in lunatic asylums—Rupture of internal organs the result of violent injuries to chest and abdomen—Wounds of the lungs—Wounds of the heart

SCALP wounds of an incised nature, unless of considerable extent, rarely produce serious effects Contused wounds of the scalp, on the other hand, are dangerous, because of their tendency to assume an erysipelatous character.

Wounds of the head

133 Wounds on the head are very various in their results The most serious injuries,—involving fracture of the skull and even loss of a portion of the brain,—are sometimes followed by perfect recovery, whereas the slightest contusions may be attended by fatal results A slight blow, leaving scarcely perceptible marks of injury, may produce abscess of the brain, and death Two of the most dangerous results of a severe blow on the head are concussion* and effusion of blood on the brain causing compression In cases of this kind death is sometimes instantaneous, but at others it does not occur until after many days

Difference between concussion of the brain and intoxication

134 Taylor points out the necessity of a careful examin-

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* *Concussion* is a lesion of the brain producing symptoms of loss of power and function of organs generally and usually caused by great violence offered to the brain itself, though no fissure, fracture of the skull, or extravasation may be discovered

ation on the part of the medical attendant in order to distinguish between concussion and the results of intoxication A man may be intoxicated, but at the same time may also be suffering from concussion Dr Taylor says * "There is nothing in the state of the brain which will enable a practitioner to distinguish whether concussion or intoxication had existed and had been the cause of the symptoms In both cases the vessels may be congested The discovery of alcoholic liquid in the stomach may lead to a presumption that the deceased had been intoxicated, while marks of violence on the head may favour the view that he had suffered from concussion At the same time, it is possible for extravasation of blood to be produced on the brain by a blow which leaves no mark of injury whatsoever Cases have occurred in which death has happened from effusion of blood on the brain without any violence, simply as the spontaneous result of violent exertion Cases of this kind are no doubt rare, but the possibility of their occurrence should make a medical man very cautious in the expression of a decided opinion where there are no marks of injuries to be found" The general condition of the blood-vessels should always be noticed in such cases, since disease of their coats would favor rupture A case is recorded in which effusion of blood on the brain has been caused by a violent blow on the neck over the jugular vein Death was instantaneous Effusion of blood on the brain may also be produced by excitement, but cases of this nature are rare, unless the excitement has been caused, or has been accompanied, by blows Where a death of this kind has occurred, careful notes should be taken of the habit of body of the deceased If of intemperate habits, or of a full habit of body, the death may have occurred from apoplexy, the result of excitement only, and not of a blow

135 Fractures of the skull are very common in this country, and are generally produced in Northern India by the *Fractures of the skull*

* Vol I p 639

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133 Wounds on the head are very various in their results The most serious injuries,—involving fracture of the skull and even loss of a portion of the brain,—are sometimes followed by perfect recovery, whereas the slightest contusions may be attended by fatal results A slight blow, leaving scarcely perceptible marks of injury, may produce abscess of the brain, and death Two of the most dangerous results of a severe blow on the head are concussion* and effusion of blood on the brain causing compression In cases of this kind death is sometimes instantaneous, but at others it does not occur until after many days

Difference between concussion of the brain and intoxication

134 Taylor points out the necessity of a careful examin-

* *Concussion* is a lesion of the brain producing symptoms of loss of power and function generally and usually caused by great violence offered to the brain itself though no fissure, fracture of the skull, or extravasation may be discovered

ation on the part of the medical attendant in order to distinguish between concussion and the results of intoxication A man may be intoxicated, but at the same time may also be suffering from concussion Dr Taylor says * "There is nothing in the state of the brain which will enable a practitioner to distinguish whether concussion or intoxication had existed and had been the cause of the symptoms In both cases the vessels may be congested The discovery of alcoholic liquid in the stomach may lead to a presumption that the deceased had been intoxicated, while marks of violence on the head may favour the view that he had suffered from concussion At the same time, it is possible for extravasation of blood to be produced on the brain by a blow which leaves no mark of injury whatsoever Cases have occurred in which death has happened from effusion of blood on the brain without any violence, simply as the spontaneous result of violent exertion Cases of this kind are no doubt rare, but the possibility of their occurrence should make a medical man very cautious in the expression of a decided opinion where there are no marks of injuries to be found" The general condition of the blood-vessels should always be noticed in such cases, since disease of their coats would favor rupture A case is recorded in which effusion of blood on the brain has been caused by a violent blow on the neck over the jugular vein Death was instantaneous Effusion of blood on the brain may also be produced by excitement, but cases of this nature are rare, unless the excitement has been caused, or has been accompanied, by blows Where a death of this kind has occurred, careful notes should be taken of the habit of body of the deceased If of intemperate habits, or of a full habit of body, the death may have occurred from apoplexy, the result of excitement only, and not of a blow

135 Fractures of the skull are very common in this country, and are generally produced in Northern India by the *Fractures of the skull*

* Vol I p 639

CHAPTER VIII.

WOUNDS, RUPTURES, AND OTHER INJURIES AS AFFECTING DIFFERENT PARTS OF THE BODY

Wounds of the head—Difference between concussion of the brain and intoxication—Fractures of the skull—Wounds on the face—Injuries to the spine—Incised wounds to the chest—Torture by *Bansdola*—Confessions obtained by police—Confessions made to police inadmissible as evidence—Ordinary occurrence in evidence of police officers—Extortion of confessions—Pressure on the chest as a means of extorting confessions—Cases of sudden death in lunatic asylums—Rupture of internal organs the result of violent injuries to chest and abdomen—Wounds of the lungs—Wounds of the heart

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lathi or bamboo, and in the Madras Presidency by the rice-pounder and frequently by pounding with a stone It is generally found that not only has one blow been struck, but a great many, and the skull is frequently fractured in several places and often smashed to pieces Fractures of this kind are generally caused in the heat of a quarrel, but it is worthy of remark that pounding with a stone is frequently the result of a deliberate act, and especially when the deceased has been suspected of sorcery A favorite punishment of a reputed sorcerer is to pound out his teeth with a stone There are also several instances of murders having been committed in this manner by women, on the persons of young children, whom they have robbed of their ornaments As regards fractures, it may be remarked that it is most difficult to produce a fracture of the skull on a body already dead Casper speaks of several experiments that he made to test this, the instrument used being the wooden mallet employed to prop up the head during dissection Fractures need not necessarily be caused on the spot where the blow falls on the head, and a severe blow on one part may produce a fracture at a point diametrically opposite to the part struck These *counter fractures*, (or fractures by *coutre-coup* as they are called), are due to the physical law, that the parts in which the force applied to any hollow dome becomes concentrated are diametrically opposed to each other (Baynes) A compound fracture of the skull, which is a common result of a blow with a blunt weapon, may likewise be caused by a fall on a sharp stone, but rarely by a fall on a flat surface

Wounds on the face

136 Wounds on the face are dangerous as generally causing deformity, owing to the risk of the brain becoming affected Injuries to the eye are of frequent occurrence, and if made by a sharp pointed instrument, such as a needle or a style, there is danger of the brain being pierced An instance is given of this in Illustrative Case No III In the same way, a sharp-pointed instrument might be inserted through the nose, and could thus reach the brain

without leaving any external mark of injury Dr. Hehir has seen two such cases A crime, by no means unfrequent, both in Bengal and in the wilder and less civilized portions of the Madras Presidency, is mutilation of a female by cutting off her nose This is generally done as a punishment for an act of adultery, and a similar incident is told in one of the stories of the Panchatantram, in which the husband, by mistake, cut off the nose of a procuress instead of his own wife

137 In many cases of sudden death, where there are no marks of violence to be found, if a careful examination is made, it will probably be found that there is injury to the spinal cord A slight injury has been known to cause death by giving rise to inflammation The spinal cord is also liable to compression from slight causes resulting in almost instantaneous death, but leaving no external marks of injury Fractures of the vertebræ or bones of the neck have occurred from very trifling causes, such as suddenly throwing the head back, and there is one recorded case (Taylor) of a fracture of this kind having been caused by a patient turning in bed while his head was compressed by the pillows In this case death did not ensue for sixteen months A child has been known to be instantaneously killed in consequence of its having been lifted up by the head Taylor remarks "Injuries to the spine and its contents are generally the results of falls or blows, either on the head or the lower part of the column The secondary consequences of these injuries are sometimes so insidious as to disarm suspicion, and death may take place quite unexpectedly some weeks after the accident" Diving head foremost into shallow streams, etc, is a well-known cause of dislocation of the vertebræ of the neck. *Injuries to the spine*

138. Incised wounds to the chest, which do not penetrate into its cavity, are seldom dangerous Contused wounds, on the other hand, are far more dangerous, and the danger is in proportion to the violence used By the fracture of a rib, or of the sternum (or breast-bone), a bone may be *Incised wounds to the chest.*

Ordinary occurrence in evidence of police officers

142 A phrase of very ordinary occurrence in the evidence of a police officer is as follows "After being for three days in our custody, one morning, about half an hour after head constable ——— had taken the prisoner to the vanka *for purposes of nature, he came back and stated that he* was willing to confess In consequence of that statement, we took him before the sub magistrate," or, "after making that statement, the prisoner took us to the jungle, where, from under a stone, he produced the stolen property," &c It is worthy of remark, that even if these statements have been extorted, they are, in a great number of cases, extorted from the actual criminals, because they are able to show where the property is hidden * On the other hand, it is very significant that the property produced very often consists of articles, such as a common cloth or a plain silver bangle, almost incapable of identification, since every other person will have articles of a similar description

Extortion of confessions

143 *There is good reason for believing that in many* cases false confessions are extorted. The accused are induced to say that they have committed the offence, and are then *told* by the police to lead the way to a certain spot where some worthless articles have been already hidden away (see Illustrative Case No XLII of a false confession) Of course, in cases of this kind, a considerable amount of violence is not used, because it would leave marks which would lead to detection A small dose, however, of *bansdola,* if judiciously administered, leaves no traces, and is capable of inflicting quite enough pain to induce a man to confess There are other ways of extorting confessions, by means which leave no traces whatsoever, such as mixing large quantities of salt with the food and then withholding water, preventing the prisoner from getting any sleep, &c ,

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[illegible]

but practices of this kind must be treated under a different head

Pressure on the chest as a means of extorting confessions

144 It is remarkable what an enormous amount of pressure the chest will bear without causing death This is proved by the immense weights which, in former years, were used to extort confessions, and as punishment for crime in Europe in the *peine forte et dure* Even in the last century this barbarous practice was still in force In 1735, at the Lewes Assizes, "a man had laid upon him, one by one, three hundredweight—then fifty pounds more 'When he was nearly dead, having all the agonies of death upon him,' the executioner, who weighed sixteen or seventeen stone, lay down upon the board which was over him, and killed him in an instant" "In January 1720, William Spigott, at the Old Bailey, bore four hundredweight on his body for more than an hour, and thereafter was hanged At the Old Bailey, in January 1721, a highwayman, after enduring the punishment an hour, and having three or four hundredweight put upon him, at last submitted to plead" (Chevers, page 141)

Cases of sudden death in lunatic asylums

145. It is by no means uncommon to find cases of sudden death in a lunatic asylum after there has been a struggle between the patient and his keeper With a violent maniac, the keeper, in closing with him, generally places his knee upon the patient's chest and endeavours to throw him down The fall of two heavy bodies, with the knee of one of them in this position, is calculated to cause severe internal injury without leaving any external signs In 1870, a case of this nature occurred in England, in the lunatic asylum of Prestwich, in which *seven* ribs were broken without leaving any external mark A very similar case occurred in 1884 in this country, when the insane Rajah of *Kolapoor* died suddenly after a struggle and a fall from his keeper

Rupture of internal organs the result of violent inj

146 It is by no means uncommon, where death has been caused by sudden violent injuries to the chest and abdomen, that the whole of the internal organs are ruptured

to chest and abdomen

without leaving any external traces of injury. *Casper* gives a remarkable case in which a wagoner was crushed by the wheel of his own cart against a tree. There were no external marks of injury, but on dissection the spleen, liver, and heart were all found to be ruptured and lacerated to a frightful extent, and the whole of the internal organs more or less affected. The same author gives another case of a sailor who was killed by the fall of a mast, and who died after six hours. *There was no trace of ecchymosis to be found over the whole body*, but the following internal injuries were found,—a small fissure in the right orbital plate of the frontal* bone, on the right side five ribs were fractured, from the third to the seventh inclusive, and about six ounces of serum were effused into the pleural† cavity, at the posterior surface of the liver there were four lacerations, obviously caused by the protruding ends of the fractured ribs, and about six ounces of blood effused into the peritoneal cavity, further, the bones of both fore arms were transversely fractured, and finally, the right femur‡ was completely splintered. A remarkable case is also quoted in the *Lancet* of April, May, or June 1884, in which a man broke a rib by overstraining himself in throwing a heavy weight. Death in these cases is caused by hæmorrhage, which may take place internally.

Wounds of the lungs

147. A wound of the lung may be recognized, among other symptoms, by the frothiness and florid colour of the blood which issues from the wound, as well as by the expectoration (or coughing up) of blood. Wounds to the lungs may be caused directly, as by stabs or gunshot, or indirectly, by the fracture of a rib or the collar bone, the end of which may lacerate the organ. The lungs may, however, be ruptured by external violence only without the fracture of a bone. A case is recorded of a boy who was killed by being driven over by a carriage. No bone

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* The bone of the forehead

† The *pleura* is the covering of the lung, consisting of two layers, between which, under certain morbid conditions, fluid may accumulate.

‡ Or thigh bone

was fractured, but the lungs were found lacerated, and the consequent internal hæmorrhage was the cause of death

148. As has been previously shown, wounds of the heart are not so instantaneously fatal, as is generally supposed, and there are many instances of persons who have survived for many days after sustaining severe injuries to that organ.* In the same way as the lungs, the injuries may be caused directly or indirectly by the fracture of a bone, or even by a severe blow, which, without breaking a bone or leaving any external mark, may yet cause a rupture of the heart. There is one case recorded of a woman who swallowed a fish-bone, which, by protruding through the stomach, perforated the heart (Taylor, Vol. I, page 659). Ruptures of the heart from natural causes are not uncommon. "Hope asserts, that in ruptures from natural causes, it is the left side of the heart, and particularly the left ventricle,† in which a rupture is most frequently found" In some cases rupture of the heart from disease may excite a suspicion of death from violence The natural causes of rupture of the heart are violent mental emotions, such as anger, fright, terror, paroxysms of passion, sudden or excessive muscular efforts, or violent physical exertions in constrained positions. If the heart is once in a diseased condition, as, for instance, fatty degeneration,‡ rupture

Wounds of the heart.

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* See Taylor, Vol 1, p 629

Case of *Duc de Berri*, who survived eight hours after a wound in the left ventricle to the heart

Medical Gazette (Vol XIV, page 334), case of a boy who survived five weeks, being employed during the time After death a mass of wood was found lodged in the substance of his heart

Case of a suicide who survived one and a quarter hours after two bullets had passed through both ventricles into the heart

† The heart contains four chambers—one *auricle* and one *ventricle* on each

and death may be brought on by very slight causes. A very slight *excitement, or even the exertion required for an* ordinary walk, has been sufficient to produce this result An injury *to the diaphragm, i e,* the muscular partition between the chest and the stomach, may prove the cause of death long after the injury has been caused The wound may heal, but the cicatrix may, by some unwonted exertion or from a slight blow, again open. Death in such cases is generally caused by some portion of the viscera obtruding through the wound and becoming strangulated

ILLUSTRATIVE CASES.

Case No XXXV —Insensibility for twenty-four hours

Mr. Gribble gives the following account of a personal experience "In 1865 I rode in a steeple-chase The horse was a very violent one, and in the middle of the course bolted We got into a nuljah of false earth The horse plunged and then sank up to the knees, turning right over and cutting open her chest, so that she had afterwards to be shot I was thrown on my head, on a laterite rock, and was picked up insensible This was early in the morning I remained insensible for twenty four hours and got up next morning perfectly well, but without the slightest recollection of what had happened the day before, or how the accident had occurred The whole day was wiped out of my life During the time of insensibility, which was caused by concussion of the brain, my ear, which, when I was picked up, was in my mouth, was sewed on, and when I awoke, I was astonished to find my head bound up I appeared next morning at early tea to the surprise of the rest of the residents of the house, who were all talking at the time of the probability of having to bury me"

Similar cases of partial loss of memory, or of "being knocked out of time," are not uncommon, and the behaviour of a person suffering from the effects of concussion, sometimes closely simulates that due to alcoholic intoxication For cases of injury to the brain, see Taylor, Vol I, 628, and particularly the case of a boy whose brain was shot completely through by the breech of a burst pistol The boy was not even rendered insensible, but died after 24 hours; also for injuries to the brain, ibid, p 649

Case No XXXVI —Cause of effusion on the brain

Reg v Phipp

A case was tried (Gloucester Summer Assizes, 1845), in which the following facts were proved: During a fight the prisoner struck the deceased a severe blow under the left ear. He fell and died in a few minutes After death blood was found extravasated on the part corresponding to the seat of violence, and this, in the opinion of the medical witness, satisfactorily accounted for death The defence was that the effusion might have been caused by over excitement, but the judge (Patterson, J) is reported to have said, that if it were proved that two people were fighting together—blows were struck—one fell to the ground and died, and afterwards internal injuries were found corresponding with the external marks of violence no power on earth could persuade him that such blows were not the cause of death The prisoner was found guilty —(*Taylor*, Vol I, p 647)

CASE NO XXXVII — CEREBRAL HÆMORRHAGE FROM A BLOW

THE pole of a wagon in motion was said to have struck an old woman of sixty five in the left side and thrown her down on the pavement She was picked up senseless and died in a few hours There was no trace of injury on the body The cranial bones, of the unusual thickness of a quarter of an inch, were also uninjured The cerebral membranes were, however, very strongly hyperæmic, and the whole brain floated, so to speak, in a layer of coagulated blood, two lines thick It was decided that this cerebral hæmorrhage (so rare in its extent) could only have been caused by external violence, and that a headlong fall upon a stone pavement was a very proba ble cause —(*Casper*)

CASE NO XXXVIII — BRAIN DAMAGED BY INJURIES TO THE FACE.

IN 1735, Macklin, the Comedian, was tried for causing the death of Thomas Hallam, by thrusting a stick into the eye On inspecting the body, it was ascertained that the stick had entered the brain through the orbit

IN 1843 a boy killed another at Liverpool, by wounding him with a gimlet in the eye The brain was perforated, and he died in two days

A BOY, aged ten, had the birch end of a common broom thrust several times into his face by one of his companions He became stunned and was carried home in a state of stupor He afterwards complained of violent pain in the eyeball and forehead Symptoms of inflammation and fever supervened, followed by coma, convulsions, and insensibility He died in about sixteen days after the accident On dissection, the orbital plate was found perforated, and pus and lymph were effused on the base of the brain The left ventricle contained three ounces of pus, it communicated with a wound in the orbit A small portion of bone was partially separated from the orbital plate and projected upwards —(*Taylor*, Vol I, page 652)

CASE NO XXXIX — FRACTURES OF THE SKULL

CHEVERS mentions many cases in which the skull has been fractured to pieces by blows and from pounding with a stone

IN 1852, three persons were sentenced to death, at Bareilly, for murder ing a man, by beating him on the face with "*lattees* and an iron coulter," the bones of the head and face were shattered to pieces, so that even the jaws and teeth were broken into small pieces

A WOMAN was sentenced to death at the same town, for the murder of a girl of ten, for the sake of her ornaments The civil surgeon found the poor child s face brutally wounded and beaten into a mass by repeated blows

IN 1856 a man was sentenced to death, at Masulipatam, for killing his wife The quarrel was a very slight one, the judge says, ' either connected with some ceremonies, in boiling water with two pots, one placed on the mouth of the other, or that deceased had allowed the marriage of their daughter to take place in the prisoner s absence" The prisoner drove the other

persons out of the house and attacked his wife with a rice pounder, beating her so severely that the rice pounder "was found broken in three pieces around the body of deceased weltering in gore"—(*Madras Foujdaree Udalut* 1850)

CASPER also gives a case of a man who killed a shoemaker whilst at work, the object being to steal a pair of shoes The prisoner confessed, that after giving the first stroke with the hammer, he became quite furious and felt as if he could keep on battering him "for ever" This confession entirely corresponded with what we found, viz, four and twenty individual injuries of the head, extending even to the face

CASE No XL.—MURDER OF SUSPECTED SORCERERS

IN 1859, at Chingleput, two persons were found guilty of having murdered a man and his wife, whom they suspected of having bewitched them The professed object was to beat out their teeth, which was done with slippers. The body of the man was found dead, the face and head being fearfully mutilated The woman died shortly afterwards and was also covered with wounds about the head and face The evidence went to show that the deceased had been pounded with stones in addition to being beaten with slippers Numerous other instances of this kind might be quoted, but this may serve as an example —(*Madras Foujdaree Udalut*, 1859)

CASE No XLI —INJURIES TO THE SPINE, DISLOCATION OF THE NECK

THIS is a very usual way of causing death in this country, especially in the case of children The neck is twisted and dislocated, causing laceration of the spinal cord In 1860 a woman was condemned to death, at Combaconum, for murdering a child in this manner, for the sake of stealing his jewels There were in this case no external marks of violence —(*Madras Foujdaree Udalut*, 1860)

TAYLOR, Vol I, page 655, mentions a case in which a man, who had been drinking, lay down to sleep in a yard intoxicated Next morning he awoke sober, but could not move his legs He was taken into hospital after twelve days and died shortly afterwards In addition to paralysis, he was suffering from peritonitis, and, on examination, the tenth dorsal vertebra was found broken in its body and arch. A large clot of blood was situated on the sheath of the cord, this had caused the paralysis It was proved, that whilst intoxicated he had a fall, after which he walked home and lay down to sleep Hence there was reason to believe that, in spite of the fractured vertebra, he had not been rendered incapable of walking The effusion of the blood which caused the paralysis could only have occurred some time after the fracture, as the result of slow oozing

CASE No XLII —TORTURE

DR CHEVERS has collected an immense amount of information on this point The practice of *bansdola*, or compression and beating, has been

alluded to in the text A few cases only will be here cited in further illustration

IN 1854, certain policemen of Dinagepore were tried for torturing a man suspected of dacoity The man died, and the civil surgeon stated "that death had been caused by congestion of blood on the brain from torture by severe pressure, and that simple beating without some such process as *bansdola* would not cause the appearances he found without more decided marks" The judge considered it to be clear that beating was performed skilfully by sharp raps on the joints, and punching and poking with *lattees*, so as not to leave any external marks, and that the *bansdola* torture was inflicted after he fell

IN the Madras Presidency, a common torture is, or rather was, by the Kittee (Telugu Cheerata), in which the fingers are placed as in a lemon squeezer or by bending back the fingers over a stick, or by squeezing the ears and also the breasts of females These tortures are all done in such a way as to leave no external marks Another mode of torture is tying up by the fingers, tying the arms and legs and rolling the body down an incline lighting a fire beneath the soles of the feet, &c Both of these last tortures were made use of in the case of the district moonsiff of Sholinghur, alluded to in the text, under the head of mutilation

CASE NO XLIII — FALSE CONFESSION

CONFESSIONS obtained by improper means are naturally often false The following is a peculiar case, and was tried before Mr Gribble at Cuddapah in 1884 —

A Mahomedan lad was charged with the murder of a boy of about ten years of age, the murder was accompanied by theft of a pair of silver bangles The accused was last seen with the deceased about dusk going out to some prickly pear bushes near the village Next day the body of the deceased was found in a shallow pond among the bushes There were marks of injury on the neck and head, and as the stomach contained muddy water, it appeared that he had been thrown in the water whilst still living The bangles were missing The prisoner was arrested on suspicion, and one of his feet was said to correspond with a footmark in the mud near where the body was found The evidence regarding this, however, was not very satisfactory This was all the evidence against the prisoner He remained in police custody for three days, and then one morning, about half an hour after the *head constable had taken him to the latrine* for the purposes of nature, a constable came and reported that the prisoner was willing to confess The sub magistrate was then sent for, and the prisoner took them all to a spot near where the body was found and from under a stone produced a pair of bangles These bangles were exactly like any other bangles with no distinguishing mark, but were sworn to by the deceased's father and by the goldsmith who made them The whole case turned upon the identity of the bangles Deceased's father swore that they had been made from Rs 16 worth of silver, and the jeweller also

swore that this was their weight when made They were then weighed in court and found to weigh only Rs 15 8 0 They had only been made ten months before and had been worn by deceased on two occasions for twenty days each It was impossible that in forty days' wear there could have been a wastage of eight annas of silver, and therefore it was clear that the bangles produced by the prisoner could not have been the bangles worn by the deceased. The only possible explanation was, that bangles resembling those worn by deceased were placed under a stone by some one else (police?) and that then the prisoner was induced to confess and was told where the bangles had been concealed In his confession (afterwards withdrawn), the prisoner said that deceased had fallen in by accident, and that he had then taken off the bangles and hidden them away because he was afraid The prisoner was acquitted It is exceedingly possible in this case that the prisoner was the murderer, but the story of the bangles was palpably false, and a false confession of this kind can only be accounted for in one way, i e, it was obtained by improper means at the latrine there were, however, no marks of injuries on the accused

CHAPTER IX.

RUPTURE OF INTERNAL ORGANS.

Deaths from rupture of internal organs—Order of frequency of rupture of internal organs—Organs most frequently ruptured—Spleen most frequently ruptured—Rupture of the spleen—Symptoms of rupture of spleen—Prognosis of rupture of spleen—Treatment of rupture of spleen—Treatment of rupture of spleen in case of internal hæmorrhage—Further remarks on rupture of the spleen—Statistics of uncomplicated rupture of spleen—Cause of rupture—Particulars of cause of rupture of spleen—Causes assigned for homicidal cases of rupture of spleen—Race and sex of cases of rupture of the spleen—External marks of violence in cases of rupture of spleen—Size of the spleen—Position and size of rupture of the spleen—Cause of death in cases of rupture of spleen—Condition of spleen in cases of rupture—Weight of spleen in cases of rupture—Statistics of complicated ruptures of the spleen—Causes of rupture of spleen—Reasons assigned for accidents—External marks of violence—Condition of spleen in foregoing cases—Size of spleen—Nature of ruptures of spleen—Situations of ruptures—Period of survival after rupture of spleen—Causes of death resulting from rupture of spleen—Percentage of causes of complicated ruptures of spleen—Nature of injuries caused to spleen—Rupture of the liver—Causes of rupture of liver—Symptoms of rupture of liver—Prognosis of rupture of liver—Ruptures of liver most common in Calcutta—Ruptures of liver only—Statistics of rupture of liver—Causes assigned for accidental cases of rupture of liver—Condition of liver in cases of rupture—Nature of ruptures of liver—Position of ruptures of liver—Size of ruptures of liver—Cause of death in cases of rupture of liver—Region where blood was effused from liver—Period of survival after rupture of liver—Analysis of causes of rupture of liver—External marks of violence—Fractured bones as complications—Diseased liver as complication—Ruptures as complication—Hæmorrhage as complication—Blood in abdominal cavity—Quantity of blood extravasated—Time between injury and death—Rupture of the bowel—Rupture of bowel caused by severe contusion—Rupture of the intestine—Rupture of intestines—Analysis of cases of ruptures of intestines—Nature of substances extravasated into abdominal cavity—Length of time deceased survived after the accident—Cause of death—Injuries to the abdomen—Remarkable case of complicated rupture of liver, spleen and kidney—Wounds to the bladder and gall bladder generally prove fatal—Rupture of the heart—Wounds of the heart—Fatality in cases of wounds and rupture of the heart—Signs of wound of the heart—Case of rupture of spleen recorded by Chevers—Period of

survival in case of rupture of spleen—Mutilation as a punishment—Difficulty in defining cause of fracture—Fractures during life and after death—Fractures as affecting locomotion—Gun shot wounds—Gun-shot wounds of entrance—Appearance of gun shot wound from conical or round bullet—Nature of gun shot injury depends upon distance from which gun was fired—Gun shot wound—Premeditation defined in case of gun shot wounds—Curious case of suicide by pistol shot—Presumption in case of gun shot wound in temple or mouth—Blank charge often causes wound like gun shot wound—Flash of discharge not unfrequently renders assassin's face distinguishable—Cut throat

Deaths from rupture of internal organs

THE frequency with which deaths from rupture of internal organs is met with in India necessitates the addition of a special chapter to this edition. We had prepared such a chapter from recorded cases scattered through the various medical journals, but the appearance of Brigade-Surgeon S. C. MacKenzie's *Medico-Legal Experiences in Calcutta* has induced us to fall back almost entirely upon his valuable contribution to our meagre knowledge on this subject. We quote freely from that author's manual. In opening the section on rupture of internal organs, Dr. MacKenzie states —"During the period of nine years embraced by my notes on the medico-legal autopsies which have come under my notice as Police Surgeon of Calcutta, there were 111 ruptures of internal organs. The following figures show the various ruptures which came under my notice and the number of each in order of frequency —

Order of frequency of rupture of internal organs

Liver alone	34
Liver and spleen	3
Liver and right kidney	2
Liver and left kidney	1
Liver, spleen, right kidney, and right lung	1
Liver, spleen, and heart	1
Liver and left lung	1
Liver and right lung	1
Spleen only	29
Spleen and liver	5
Spleen and brain	1
Spleen and left kidney	3
Spleen and stomach	1
Spleen and left lung	1

Spleen, spinal cord, diaphragm, right kidney, bladder, liver, heart, right lung, and left lung	1
Spleen, liver, and right kidney	1
Intestines only	11
Intestines and liver	1
Heart only	5
Heart and spleen	1
Bladder only	2
Ureter only	1
Kidney only	1
Kidney and liver	1
Uterus and vagina	1"

Organs most frequently ruptured

150 From the foregoing it list will be seen that ruptures of the liver, spleen, intestines, and heart, were most frequently met with, and it is to these that we propose to confine our attention General experience is not in accord with Brigade-Surgeon MacKenzie's as to the relative frequency of rupture of internal organs

Spleen most frequently ruptured

151 Of all internal organs the *spleen* is the one most frequently ruptured, although, as has been seen, this accident was met with less frequently than rupture of the liver in Dr MacKenzie's 111 cases It is almost natural to expect that the spleen would be the organ most commonly damaged in injuries of the abdomen, when we consider that a large proportion of the people of India are more or less constantly suffering from malarial enlargement of that organ

Rupture of the spleen

152 The causes of *rupture of the spleen* are,—blows, kicks, falls, wheels of vehicles passing over the organ, penetration by fractured ribs, gun-shot injuries, etc

Symptoms of rupture of spleen

153 The nature and position of the injury received must be borne in mind, as there are no distinctive symptoms There will be marked general shock, anxious countenance, coldness of the trunk and extremities, feeble pulse, sighing respiration, abdominal pain—especially over the seat of

injury, and dullness on percussion* over the splenic area due to extravasated blood

154 The prognosis† is unfavourable, as, owing to the vascularity of the organ, the hæmorrhage is generally severe, even more so than when the liver is similarly injured If the substance of the spleen be not very extensively torn, recovery may take place In the surgical history of the American War three cases of recovery are recorded, two being the result of gun shot injuries and the third a bayonet wound If the shock and hæmorrhage do not lead to an immediately fatal result, peritonitis‡ and abscess are the complications to be feared — *Prognosis of rupture of spleen*

155 The treatment consists of rest in the horizontal position, warmth to the general surface of the body, ice, or warm fomentations over the region of the spleen, morphine subcutaneously or by the rectum to relieve pain, brandy or egg flip in teaspoonful doses at short intervals. — Treatment of rupture of spleen

156. Should symptoms of internal hæmorrhage continue whilst no external wound exists, abdominal section§ at the edge of the left rectus muscle is to be recommended If laparotomy show that the hæmorrhage will not cease by exposure, or the application of the thermo-cautery,‖ the splenic artery may be ligatured, or the spleen itself removed, either directly or by means of a ligature This last procedure has been successfully accomplished All blood must be cleared from the peritoneum and the abdominal cavity be thoroughly washed out with some warm — Treatment of rupture of spleen in case of internal hæmorrhage

* The word *percussion* is the process of striking lightly upon any part of the body, especially the thorax or abdomen with the view of ascertaining morbid conditions by the resonance of the stroke

† The word *prognosis* in practical medicine and surgery is applied to the prevision and judgment regarding the progress and result of a disease

‡ *Peritonitis* is inflammation of the membrane lining the interior of the abdominal cavity and surrounding the viscera

§ *Abdominal section* or *laparotomy* is the opening of the abdominal cavity by incision

‖ The process of *thermo cautery* (also called Paquelin s cautery) referred to is the application of a hollow platinum point kept at a uniform temperature by a current of benzene vapour.

antiseptic lotion, carefully sponged dry, and closed after the introduction of a glass drainage tube *

Further remarks on rupture of the spleen

157 As a result of his Calcutta experiences, Dr MacKenzie remarks —" After ruptures of the liver, ruptures of the spleen have been most commonly observed in the course of my medico legal experience in Calcutta During the period of nine years that I have been considering, I met with 43 cases, of which 29 were not complicated with ruptures of other organs, and 14 in which one or more of the other internal organs were injured I propose to deal with ruptures of the spleen, under two heads First, those in which the only lesion was one or more ruptures of this organ, and, secondly, those in which the ruptures of the spleen were complicated with ruptures of other viscera

Statistics of uncomplicated rupture of spleen

158 " There were recorded in the period referred to, 29 cases, or 67 4 per cent of uncomplicated ruptures of the spleen

Cause of rupture.

159 " These 29 ruptures were referred to the following causes —In 23 or 79 3 per cent to accidents, in 4 or 13 7 per cent to homicide, and in 2 or 6 8 per cent the injuries were spontaneous ruptures

Particulars of cause of rupture of spleen

160 " Of these 5 or 21 7 per cent were results of kicks from horses, all on persons of syces or grooms, 5 or 21 7 per cent were owing to falls from heights as from off the roofs of houses, etc , 3 or 13 per cent were caused by heavy weights falling on the region of the abdomen of coolies or porters—in the first case by a bag of country produce falling on a coolie, in the second by a bale of jute striking a coolie, and, in the third, by a heavy wooden case or box falling on a coolie, 3 or 13 per cent were cases of persons falling into the holds of ships and pontoons, 2 or 8 6 per cent were cases of persons knocked down and injured by runaway horses, 1 or 4 3 per cent was caused by a country boat being swept by the violence of the bore or tide under a steamer, and one of the crew being crushed between the boat and the

* HEATH's Dictionary of Practical Surgery Vol I p. 472

vessel; 2 or 8 6 per cent were of men falling down on the road and off steps, 1 or 4 3 per cent of the cases was that of a boy subject to epileptic fits—the rupture was the result of the kind attentions of his mother, who, to relieve the pain he complained of in his abdomen, rubbed it for sometime with her hands. In 1 or 4 3 per cent. of the cases no cause was assigned.

Causes assigned for homicidal cases of rupture of spleen

161. "Of the homicidal cases, in 2 or 50 per cent they were due to blows, one in a quarrel and one in a drunken brawl, the blow in this case being inflicted with a large heavy wooden pin, in 1 or 25 per cent by being pushed against a brick wall; and in 1 or 25 per cent. of the cases, death was the result of a kick received by a native from a European.

Race and sex of cases of rupture of the spleen

162. "Of the 27 persons who died from uncomplicated ruptures of the spleen, 24 or 82 7 per cent. were adult native males, 3 or 10 3 per cent were adult females, 1 or 3 4 per cent. was a native boy, and 1 or 3 4 per cent. a native girl.

External marks of violence in cases of rupture of spleen

163 "In 20 or 68 9 per cent of these cases no external marks of violence could be detected, and in 9 or 31 per cent they were present.

Size of the spleen

164. "The following statement shows the size of the spleen ruptured —

Number of cases	Length of spleen	Breadth of spleen
2	12 inches	7 inches
2	11 ,,	8 ,,
1	12 ,,	9 ,,
1	12 ,,	4 ,,
1	12 ,,	3 ,,
1	9½ ,,	5½ ,,
1	9 ,,	8 ,,
1	8¼ ,,	6 ,,
1	8½ ,,	5 ,,
1	8 ,,	5 ,,
2	7 ,,	5 ,,
1	7 ,,	4½ ,,

Position and size of rupture of the spleen

165 "The position of the ruptures in these 29 cases were as follow —In 9 or 31 per cent they were on the inner surface and through the hilus, in 4 or 13 7 per cent on the inner surface, in 2 or 6 8 per cent on the inner surface of the lower end, in 2 or 6 8 per cent on the inner surface of the upper end, in 1 or 3 4 per cent on the inner surface, the lower end, and the outer surface, in 1 or 3 4 per cent on the outer surface, in 2 or 6 8 per cent on both surfaces, in 2 or 6 8 per cent on both surfaces and at the upper end, in 1 or 3 4 per cent at both ends, through the hilus and the posterior border, in 1 or 3 4 per cent at the lower end, in 2 or 6 8 per cent through the whole substance of the spleen, and in 2 or 6 8 per cent the organ was reduced to pulp

Cause of death in cases of rupture of spleen

166 "The cause of death in 37 1 per cent of Dr MacKenzie's cases was hæmorrhage, while in the non complicated ruptures 86 2 per cent died from loss of blood, in these cases 35 7 per cent died from shock, in the other class, 6 8 per cent in the uncomplicated cases, 3 4 per cent died from the combined effects of shock and hæmorrhage, while in the complicated ones, 7 1 per cent died from the same causes"* Putrefaction had not commenced in any of the 29 cases of complicated rupture when examined

Condition of spleen in cases of rupture

167 "This organ in 28 or 96 5 per cent of the cases was found to be diseased, and in only 1 or 3 4 per cent to be healthy

Weight of spleen in cases of rupture.

168 "The weight of the spleen was not taken in 20 or 68 9 per cent of the cases, and in 9 or 31 per cent it was found to vary from 10 ounces to 3 lbs 14 ounces

Statistics of complicated ruptures of the spleen.

169 Regarding complicated ruptures of the spleen, Dr MacKenzie says —"Out of 43 ruptures of the spleen, 14 or 32 5 per cent were accompanied by injuries of other organs Of these, 5 or 33 7 per cent were complicated with ruptures of the liver, 3 or 21 4 per cent with rupture

* *Medico-Legal Experiences in Calcutta*, pp 85 86

of the left kidney, 1 or 7 1 per cent with laceration of the brain, 1 or 7 1 per cent of the stomach, 1 or 7 1 per cent with lacerations of the left lung, 1 or 7 1 per cent with injuries of both lungs, the heart, the spinal cord, liver, bladder right kidney, and diaphragm, 1 or 7 1 per cent with lacerations of the left lung and ruptures of the liver and right kidney and 1 or 7 1 per cent with lacerations of the right lung and ruptures of the liver

Causes of rupture of spleen

170 On the causes of rupture, he remarks —"Of these 14 ruptures, 13 or 92 8 per cent were the result of accident and 1 or 7 1 per cent was homicidal"

Reasons assigned to accidents

171 "In 5 or 38 4 per cent the cause was falling into the holds of vessels, in 3 or 23 per cent falls from heights, as from roofs of houses and from off high ladders, in 2 or 15 3 per cent the injuries resulted from being knocked down by runaway horses, in 2 or 15 3 per cent persons were crushed by brick buildings falling on them, and in 1 or 7 6 per cent from being run over by a cart —this case was that of a boy who fell off the front of a bullock cart, and a wheel of the cart passed over his body '

External marks of violence

172 In 11 or 78 5 per cent external marks of violence were found, and in 3 or 21 4 per cent they were absent

Condition of spleen in foregoing cases

173 "The spleen in 13 or 92 8 per cent of the cases was diseased and in 1 or 7 1 per cent was healthy"*

Size of spleen

174 Concerning the size of the spleen in Dr MacKenzie's cases, he remarks —"In 1 or 7 1 per cent the spleen was noted as being large, in 3 or 21 4 per cent no notes were made, in 1 or 7 1 per cent the size was 11 inches long and 6½ inches broad, in 1 or 7 1 per cent it was 9½ inches long and 7 inches broad, in 1 or 7 1 per cent it was 9 inches long and 5 inches broad, in 1 or 7 1 per cent it was 6 inches long and 4 inches broad, and in 1 or 7 1 per cent the organ was said to be small"—*Ib*, p 81

* MACKENZIE'S *Med co Legal Experiences in Calcutta* pp 80 81

Nature of ruptures of spleen

175 "The spleen in 5 or 35 7 per cent of cases was ruptured into pulp, in 2 or 14 2 per cent the rupture was through the whole thickness of the organ, in 1 or 7 1 per cent the ruptures were both deep and superficial, in 1 or 7 1 per cent they were deep, and in 5 or 35 7 per cent no records could be found"

Situations of ruptures

176 The situations of the ruptures of the spleen in these 14 cases were as follows —"In 2 or 14 2 per cent they were through the whole thickness of the viscus, in 2 or 14 2 per cent they were on the inner surface and through the hilus,* in 3 or 21 4 per cent the inner surface was reduced to pulp, in 1 or 7 1 per cent the rupture was through the inner surface, the hilus, and the lower end, in 1 or 7 1 per cent at the inner surface, the hilus, and upper end, in 1 or 7 1 per cent on the inner surface, in 1 or 7 1 per cent the inner surface and upper end were ruptured into pulp, in 1 or 7 1 per cent they were on both surfaces, in 1 or 7 1 per cent they were confined to the outer surface and anterior margin, and in 1 or 7 1 per cent the whole spleen was a mass of pulp In 4 or 28 5 per cent there were two ruptures, in 5 or 35 7 per cent the organ was reduced to pulp, in 4 or 28 5 per cent there was one rupture, and in 1 or 7 1 per cent there were 5 ruptures "†

Period of survival after rupture of spleen

177 As to the length of time the persons survived after receipt of rupture of the spleen, the following quotation is interesting —"In 6 or 42 8 per cent death was said to have occurred instantaneously, in 2 or 14 2 per cent within half an hour, in 1 or 7 1 per cent in about an hour, in 1 or 7 1 per cent in 2 hours and 15 minutes, in 1 or 7 1 per cent in 5 hours 15 minutes, in 1 or 7 1 per cent in 6 hours, in 1 or 7 1 per cent it was reported as having occurred 'shortly after,' and in 1 or 7 1 per cent no notes could be found"—*Ib*, pp 82 83

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* The hilus or hilum referred to is the fissure or depression found on the internal or concave surface of the spleen

† MACKENZIE'S *Med co Legal Experiences in Calcutta* p 81

178 As to the cause of death, Dr MacKenzie notes — "Death resulted from hæmorrhage in 8 or 57 1 per cent of these cases, from shock in 5 or 35 7 per cent, and from shock and hæmorrhage combined in 1 or 7 1 per cent" Causes of death resulting from rupture of spleen

179 Dr MacKenzie states that "92 8 per cent of the complicated ruptures of the spleen were the result of accidents, and 7 1 per cent was a homicidal case, and there was not a single case of spontaneous rupture The accidents which caused these ruptures were of a severe character—71 4 per cent of the victims having suffered from violence enough to break their bones The injuries occurred in the persons of natives only, the majority of whom were adult males" Percentage of causes of complicated ruptures of spleen

180 "In all these ruptures in which notes were retained regarding the nature of the injuries, they were found to be of a severe character As in the non complicated cases, so in the majority of these, the inner surface of the spleen was injured As in the other class of injuries of the spleen, more than a single rupture, as well as the spleen being reduced to a state of pulp, were present in the majority of these cases As found in the other ruptures of the spleen, in most of the complicated (cases) a large quantity of blood was extravasated into the abdominal cavity" Nature of injuries caused to spleen

181 From its size, the liver is one of the most frequently ruptured of the abdominal viscera Either surface of the organ may be torn, but the upper is more frequently so affected, and an organ that is diseased is more prone to suffer than one of normal texture Several degrees of rupture are met with, varying from a slight superficial crack to conversion into a complete pulp The parenchymatous tissue may sometimes be torn while the peritoneal covering of the organ is left intact Rupture of the liver

182 Blows, falls, spent shot taking effect in the hepatic region, wheels of vehicles passing over the abdomen, frac- Causes of rupture of liver

tured ribs perforating the diaphragm* are among the most frequent causes of rupture of the liver

Symptoms of rupture of liver

183 As there are none that are strictly diagnostic the presence of a communicating wound or the performance of laparotomy can alone lead to an accurate estimate The precise nature of the injury and the region of the abdomen must be considered Shock, if the rupture be of any extent, is well marked the general surface of the body is pallid and cold, vomiting, thirst, and general restlessness, sighing respiration, and feeble pulse are present, together with pain and tenderness in the region of the liver, but these latter symptoms are likewise present when the organ is merely bruised An increase in the faintness and feebleness of the pulse denotes that the hæmorrhage is continuing, and that an accumulation is taking place in the peritoneal cavity, which will be recognised by a gradually widening area of dulness on percussion If not speedily fatal jaundice and itching of the skin may supervene Should an external wound exist, bile may be discharged through it

Prognosis of rupture of liver

184 This depends upon the size of the rupture If it be of any magnitude death takes place in a few hours from shock and hæmorrhage Small ruptures may be recovered from, and very superficial cracks may pass undetected If the immediate dangers be overcome, the subsequent ones that threaten are peritonitis and abscess due to the extravasation of blood and bile When the serous covering of the organ is not torn, the chances of recovery are enhanced †

Ruptures of liver most common in Calcutta

185 Dr MacKenzie states as follows —"The ruptures most commonly met with in my experience in Calcutta have been those of the liver I propose to divide these ruptures into those of the liver only, and those of the liver complicated with ruptures of one or more other organs"

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* *The diaphragm* is the large muscular partition separating the abdominal from the thoracic cavity

† HEATH's *Dictionary of Practical Surgery* Vol I pp 932 933

186 In 34 or 30 6 per cent of the cases the ruptures were those of the liver alone

Ruptures of liver only

187 Of these 34 cases, 33 or 97 05 per cent were the result of accident and only 1 or 2 94 per cent was a case of homicide

Statistics of rupture of liver

188 Fourteen cases were said to have been caused by being knocked down by runaway horses in or outside carriages and by bullock carts, 8 resulted from falls into the holds of ships and boats, 2 resulted from falls on piles of bricks, 1 was that of a man who was knocked down while helping to remove a boiler—the boiler rolled on his back and crushed him to death, 1 was that of a man struck by a tub full of salt, which was being removed from a ship's hold, 1 was that of a coolie or porter, who, while carrying a heavy box on his head, slipped and fell on his back with the box on the front of his chest and abdomen, 1 was that of a man, who, while working on board a ship, was struck by a sling containing three 2 maund bags of *dal*, 1, a drunken man, fell heavily on a hard metal rod, 1, a syce or groom, was kicked over the abdomen by a horse he was grooming, 1, a lad in a fishing boat which collided with a pontoon of the Hooghly Bridge, was precipitated into the river, and either was driven by the current against the pontoon, or against its mooring chains a few yards below the pontoon, 1 was that of a man struck by the handle of a winch in motion

Causes assigned for accidental cases of rupture of liver

189 In the 34 cases, the liver was found to be healthy in 6 or 17 6 per cent, diseased in 26 or 76 4 per cent, and no note was found in 2 or 5 8 per cent

Condition of liver in cases of rupture

190 Of the 34 cases mentioned, in 16 or 47 05 per cent the ruptures were deep, in 4 or 11 7 per cent the whole or the greater portion of the liver was ruptured into pulp, in 2 or 5 8 per cent the ruptures were both superficial and deep, in 2 or 5 8 per cent they were superficial only, and in 10 or 29 4 per cent no notes were kept.

Nature of ruptures of liver

Position of ruptures of liver

191 Of the 34 cases, in 6 or 17 6 per cent the ruptures were on the upper surface of the right lobe, in 3 or 8 8 per cent they were on the under surface of the right lobe, in 5 or 14 7 per cent through the whole substance of the right lobe, in 4 or 11 7 per cent the right lobe was ruptured into pulp, in 3 or 8 8 per cent the injury was confined to the posterior margin of the right lobe, in 1 or 2 9 per cent to the anterior margin of the right lobe, in 2 or 5 8 per cent through the junction of the right and left lobes, in 2 or 5 8 per cent the ruptures were on both surfaces of the right lobe, in 1 or 2 9 per cent they were on the posterior margin of the right lobe, and on the under surface of the left lobe, in 1 or 2 9 per cent on the under surface of the left lobe, in 1 or 2 9 per cent on both surfaces of the right and left lobes, in 1 or 2 9 per cent on the anterior margins of the right and left lobes, in 2 or 5 8 per cent through the whole substance of the right and left lobes, and in 2 or 5 8 per cent no record was kept

Size of ruptures of liver

192 In 11 or 32 3 per cent of these 34 cases, the length of the ruptures varied from 2¼ to 5 inches, in 4 or 11 7 per cent they were from 5 to 10 inches long, in 1 or 2 9 per cent the rupture was 12 inches in length, in 6 or 17 6 per cent the organ was reduced to a state of pulp, and in 12 or 35 2 per cent no note was preserved

Cause of death in cases of rupture of liver

193 Out of these 34 cases of rupture, in 18 or 52 9 per cent *the cause of death was hæmorrhage, in 15 or 44 1* per cent death resulted from shock, and in 1 or 2 9 per cent it was due to shock as well as hæmorrhage These notes show that the common cause of ruptured liver is accident, and the most frequent cause of these being people knocked down by runaway horses and by bullock carts

Region where blood was effused from liver

194 In 32 or 94 1 per cent of the 34 cases, the effused blood was found in the abdominal cavity, in 1 or 2 9 per cent in both pleural cavities, and in 1 or 2 9 per cent into both pleural and abdominal cavities In the last two cases

mentioned one or more ruptures or injuries of the diaphragm were found

195 Of the 34 cases, in 6 or 17 6 per cent death was reported to have occurred instantaneously, in 11 or 32 3 per cent within an hour, in 4 or 11 7 per cent in from one to two hours, in 1 or 2 9 per cent from two to three hours, in 4 or 11 7 per cent in three to seven hours, in 1 or 2 9 per cent in three days, and in 7 or 20 5 per cent the time was not mentioned by the police authorities

Period of survival after rupture of liver

196 On these facts Dr MacKenzie makes the following remarks —20 per cent of the cases were accidents on board ships and boats, and 40 per cent resulted from carriage, tram, or cart accidents All the European males were sailors, and 50 per cent of the adult native males were lascars or native seamen, 20 per cent were native boys, and 1 or 10 per cent was a girl

Analysis of causes of rupture of liver

197 External marks of violence were present in 80 per cent of the cases and absent only in 20 per cent The external marks were found in only 25 per cent of the cases in the hepatic* region, as well as in other parts of the body, while in 75 per cent these were found in other parts of the body distinct from the hepatic region

External marks of violence

198 Bones were found fractured in 80 per cent of cases, showing that the nature of the accident was of a violent character In all these cases, ribs were found to have been fractured, and in 37 5 per cent the ribs as well as other bones were broken

Fractured bones as complications

199 The liver was found in 60 per cent to be diseased, in 30 per cent it was healthy, and in 10 per cent no record was kept From the nature of these ruptures, it will be seen that the liver was, in the 70 per cent of cases in which notes were kept, found to be seriously and irrecoverably injured

Diseased liver as complication

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* The *hepatic* region is the region where the liver is situated

Rupture as complication

200 The ruptures in 70 per cent of the cases were limited to the right lobe, in 20 per cent they were found in the right and left lobes, and in 10 per cent the whole of the liver was ruptured and reduced to pulp

Hæmorrhage as complication

201 In half the cases, the persons who received the injuries died from shock, and in the others from hæmorrhage

Blood in abdominal cavity

202 Blood was found in the abdominal cavity in 70 per cent of the cases, in 20 per cent in the abdominal and pleural cavities, and in 10 per cent no notes were made

Quantity of blood estimated

203 In 70 per cent of the cases, the quantity of blood found varied from 8 to 90 ounces, in 20 per cent it was noted only as a "large quantity," and in 10 per cent it was not recorded In the majority of the cases in which the condition of the blood effused was recorded, it was found to be fluid and of a dark colour

Time between injury and death

204 In all the cases regarding which notes were found, the persons died within an hour of the receipt of the injury "

Rupture of the bowel

205 Rupture of some part of the intestine is a tolerably frequent and a very fatal injury It occurs in any part of the bowel, 'from the commencement of the duodenum* to the termination of the sigmoid flexure† of the colon' (Pollock) The laceration varies in extent, being sometimes little more than a pin-hole, at others involving the whole or almost the whole circumference of the bowel

Rupture of bowel caused by severe contusion

206 "The injury is caused by severe contusion, such as the kick of a horse or the passage of a wheel over the abdomen when the intestine is full; for there is no evidence,

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* The duodenum is the first part of the small intestines situated just below the stomach, continuous with the stomach

† The sigmoid flexure is the lower end of the colon or large intestines continuous with the descending colon above and the rectum below

as far as I know that the intestine can be ruptured when collapsed and this is a very important distinction between rupture from contusion and perforation from direct wound. Many instances of sword and bullet wounds of the intestines have been recorded in which recovery has ensued, though the occurrence of fæcal fistula* has proved the reality of the lesion of the bowel. And such cases are easily intelligible if we suppose that the bowel was empty at the time of the wound, so that no fæcal fluid or gas escaped into the peritoneal cavity at the moment of the perforation. For the mucous membrane protrudes at once through the lips of the wound in the muscular and serous coats, and, assisted by the contraction of the muscular fibres,† so effectually closes the aperture, that no extravasation takes place at the moment of the wound, nor would any extravasation occur at all if renewed distension could be prevented. By the time that the injured bowel becomes distended with fæces, its wounded part has contracted adhesions to the neighbouring coils and to the parietes (or walls), so that the fæces find their way out of the external wound not into the peritoneal cavity. This protrusion of the mucous coat occurs also in the case of internal rupture. But here, since the bowel is distended when ruptured and as there is no other exit for the contents except through the wound there must occur, instantaneously on the rupture, a free escape of fæcal gas at any rate, and in all probability an effusion also of fæcal fluid into the peritoneal cavity, though the latter may sometimes be in such small amount as not to be discoverable after death. Thus the germs of fatal inflammation‡ are in all probability implanted on the serous membrane, and there is not, as far as I can discover, any perfectly satisfactory proof that complete rupture

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* A *fistula* may be defined as a suppurating tube-like passage.

† The *intestines* have for the most part four coats—an *internal* (1) mucous and (2) submucous, (3) middle or muscular and (4) external or serous, the latter being derived from the peritoneum.

‡ All the more acute forms of inflammation are considered at the present day to be due to the action of certain forms of micrococci.

through all the coats of the bowel without external wound has ever been followed by recovery At the same time, there have unquestionably been cases in which the symptoms have been held to justify the diagnosis of ruptured bowel which have ended in recovery, and the theoretical possibility of recovery, even in cases of complete rupture, has not been disproved, for we are not entitled to assert that the effusion of fæcal gas must inevitably prove fatal, and there is again the remote possibility that, although the bowel may be ruptured, yet the rupture may not implicate the peritoneum, consequently the injury must be treated with a view to recovery

Rupture of the intestine

207 "Rupture of the intestine can generally be diagnosed After a severe blow on the abdomen, acute pain comes on shortly before the pain of the injury has subsided, often accompanied with much collapse (though not always so), with urgent vomiting, intense thirst, great tenderness of the abdomen, involuntary contraction of the abdominal muscles, usually rapid sinking with coldness of the surface, lividity, and loss of pulse some time before death As the case goes on, the vomit, which at first consists merely of food, becomes bilious, and then more and more resembles the contents of the small intestines, but I have never seen absolute fæcal vomiting Tympanites* usually succeeds, probably from paralysis of the bowel—the result of an impression on the sympathetic system of nerves † The collapse which depends on general shock may, as Mr Le Gros Clark points out, be distinguished from that caused by hæmorrhage, since in the latter case the patient usually refers his suffering to some isolated spot, where fulness or dulness on percussion, or both, may be detected" ‡

* *Tympanites* popularly called drum belly is the distension of the abdominal walls with gas contained in the intestines

† *The sympathetic system of nerves* is a double chain of little nerve masses intercommunicating by cross bands of nerve fibres and situated upon the front of the vertebræ from the base of the skull to the end of the spinal column It may be traced into the head

‡ HOLMES *Surgery: Its Principles and Practice* 3rd Edition p 209 *et seq*

208 Dr MacKenzie states —"The next in order of frequency, after the rupture of the spleen, I found to be the *rupture of the intestines* There were 12 ruptures of the intestines 11 or 91 6 per cent of these were uncomplicated with injuries to other internal organs, while 1 or 8 3 per cent was accompanied with two superficial ruptures of the liver As I did in case of the ruptures of the liver and spleen, I propose to consider these cases also under two heads—those in which the only rupture was that of the intestines, and the case in which it was accompanied with ruptures of the liver

Rupture of intestines

209 Of these 11 cases, 10 or 90 9 per cent were accidental, and 1 or 9 per cent was homicidal In 4 or 40 per cent the persons injured were kicked in the abdomen by horses, in 2 or 20 per cent persons were struck in the abdomen by pieces of wood, in 1 or 10 per cent a person was run over by a carriage, in 1 or 10 per cent it resulted from a fall on a large piece of timber, in 1 or 10 per cent of the cases a person was jammed between a boat and a pontoon, and in 1 or 10 per cent a man was crushed between two railway trucks Ten or 90 9 per cent were adult native males, and 1 or 9 per cent was a Eurasian boy In 2 or 18 1 per cent the intestines were ruptured in two places, and in 9 or 81 9 per cent in one In 3 or 27 2 per cent fæcal matter and fluid were found in the abdominal cavity, in 2 or 18 1 per cent fæcal matter and blood, in 2 or 18 1 per cent no extravasation had taken place, in 1 or 9 per cent only blood was found, in 1 or 9 per cent blood and fluid, in 1 or 9 per cent fæces, fluid, and blood, and in 1 or 9 per cent fæces alone

Analysis of cases of ruptures of intestines

Nature of substances extravasated into abdominal cavity

210 One or 9 per cent died in seven hours, 1 or 9 per cent in twelve hours, 2 or 18 1 per cent in twenty four hours, in 1 or 9 per cent in twenty nine hours, 2 or 18 1 per cent in thirty hours, 1 or 9 per cent in fifty-eight hours, 1 or 9 per cent in three days, 1 or 9 per cent in five days, and 1 or 9 per cent in eight days.

Length of time deceased survived after the accident

through all the coats of the bowel without external wound has ever been followed by recovery At the same time, there have unquestionably been cases in which the symptoms have been held to justify the diagnosis of ruptured bowel which have ended in recovery, and the theoretical possibility of recovery, even in cases of complete rupture, has not been disproved, for we are not entitled to assert that the effusion of fæcal gas must inevitably prove fatal, and there is again the remote possibility that, although the bowel may be ruptured, yet the rupture may not implicate the peritoneum, consequently the injury must be treated with a view to recovery

Rupture of the intestine

207 "Rupture of the intestine can generally be diagnosed After a severe blow on the abdomen, acute pain comes on shortly before the pain of the injury has subsided, often accompanied with much collapse (though not always so), with urgent vomiting, intense thirst, great tenderness of the abdomen, involuntary contraction of the abdominal muscles, usually rapid sinking with coldness of the surface, lividity, and loss of pulse some time before death As the case goes on, the vomit, which at first consists merely of food, becomes bilious, and then more and more resembles the contents of the small intestines, but I have never seen absolute fæcal vomiting Tympanites* usually succeeds, probably from paralysis of the bowel—the result of an impression on the sympathetic system of nerves † The collapse which depends on general shock may, as Mr Le Gros Clark points out, be distinguished from that caused by hæmorrhage, since in the latter case the patient usually refers his suffering to some isolated spot, where fulness or dulness, on percussion, or both, may be detected "‡

* *Tympanites* popularly called "drum belly" is the distension of the abdominal walls with gas contained in the intestines

† *The sympathetic system of nerves* is a double chain of little nerve masses intercommunicating by cross bands of nerve fibres and situated upon the front of the vertebræ from the base of the skull to the end of the spinal column It may be traced into the head

‡ HOLMES *Surgery: Its Principles and Practice* 3rd Edition p 209 *et seq*

208 Dr MacKenzie states —' The next in order of frequency, after the rupture of the spleen, I found to be the *rupture of the intestines* There were 12 ruptures of the intestines 11 or 91 6 per cent of these were uncomplicated with injuries to other internal organs, while 1 or 8 3 per cent was accompanied with two superficial ruptures of the liver As I did in case of the ruptures of the liver and spleen, I propose to consider these cases also under two heads—those in which the only rupture was that of the intestines, and the case in which it was accompanied with ruptures of the liver

Rupture of intestines

209 Of these 11 cases, 10 or 90 9 per cent were accidental, and 1 or 9 per cent was homicidal In 4 or 40 per cent the persons injured were kicked in the abdomen by horses, in 2 or 20 per cent persons were struck in the abdomen by pieces of wood, in 1 or 10 per cent a person was run over by a carriage, in 1 or 10 per cent it resulted from a fall on a large piece of timber, in 1 or 10 per cent of the cases a person was jammed between a boat and a pontoon, and in 1 or 10 per cent a man was crushed between two railway trucks Ten or 90 9 per cent were adult native males, and 1 or 9 per cent was a Eurasian boy In 2 or 18 1 per cent the intestines were ruptured in two places, and in 9 or 81 9 per cent in one In 3 or 27 2 per cent fæcal matter and fluid were found in the abdominal cavity, in 2 or 18 1 per cent fæcal matter and blood, in 2 or 18 1 per cent no extravasation had taken place, in 1 or 9 per cent only blood was found, in 1 or 9 per cent blood and fluid, in 1 or 9 per cent fæces, fluid, and blood, and in 1 or 9 per cent fæces alone

Analysis of cases of ruptures of intestines

Nature of substances extravasated into abdominal cavity

210 One or 9 per cent died in seven hours, 1 or 9 per *cent in twelve hours, 2 or 18 1 per cent in twenty four* hours, in 1 or 9 per cent in twenty nine hours, 2 or 18 1 per cent in thirty hours, 1 or 9 per cent in fifty-eight hours, 1 or 9 per cent in three days, 1 or 9 per cent in five days, and 1 or 9 per cent in eight days

Length of time deceased survived after the accident

Cause of death

211. In 9 or 81.8 per cent the cause of death was peritonitis, and in 2 or 18.1 per cent it resulted from shock.

Injuries to the abdomen

212. *Incised wounds and contusions on the abdomen* are likely to be of a very dangerous nature, owing to the slight protection afforded by the outer covering and the ease with which the vital organs may be affected. A blow on the upper part of the abdomen, "the pit of the stomach," may cause instant death without producing laceration or contusion of any organ. This effect is generally ascribed to concussion of the semi lunar ganglia* of the sympathetic† nerve. A blow on the abdomen may cause death by rupture of the spleen, of the liver, of the intestines, of the bladder, or of the gall bladder, and leave no external trace whatsoever. Ruptures of the spleen are especially common in this country, where, in feverish parts, nearly one half of the people have spleens more or less diseased and enlarged. Rupture of the spleen is almost invariably fatal, but the period within which death takes place differs considerably. Sometimes it is instantaneous, and at others it has only followed after a considerable time.

Remarkable case of complicated rupture of liver spleen and kidney

213. A very remarkable case is given by Dr. Fayrer, in which a Hindoo was admitted into the hospital with a fracture of the left fore-arm and compound dislocation of the right wrist joint, caused by a fall from a tree. For the first two days he complained of pain in the hypogastrium‡ and passed bloody urine. These symptoms gradually passed off, and the secretions became normal. The injuries to the arm, however, assumed an unfavourable aspect; tetanus set in, the arm was amputated, and he died sixteen days after the accident. On examination the liver was found

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* The semi lunar ganglion is a group of nerve cells situated in the upper and back part of the abdominal cavity and supplying nerve influence to the vessels of the organs contained in the abdominal cavity.

† The sympathetic nerve here referred to is a double chain of nerve ganglia passing down one on each side of the front of the spinal column.

‡ The region situated at the lowest part of the abdomen in the middle line.

to be ruptured, there were two ruptures in the spleen, and there was an extensive rupture in the left kidney And yet with all these injuries the patient, except for the first few days, appeared to suffer no evil effects, and, as far as could be judged, death was caused only by the injuries to the arm For other remarkable cases of injuries to the spleen and liver, see Chevers, page 460, Taylor, Vol I, page 667, Casper, Vol I

214 *Wounds to the bladder and the gall bladder* generally prove fatal, the latter causing peritonitis A case is related by Taylor (Vol I, page 633) of a gentleman who had been prevented, from some cause or other, from retiring to his room, and who felt pain from distension of the bladder Whilst going downstairs, he accidentally struck his abdomen against some projection The pain at once passed away, and also the desire to pass urine He then went out to the house of a friend, where he was engaged to dine A doctor, one of the guests, to whom he told this, at once suspected that rupture of the bladder had taken place This proved to be true, the symptoms set in almost immediately, and the gentleman died in three or four hours

Wounds to the bladder and gall bladder generally prove fatal

215 *Rupture of the heart* is generally caused by severe compression of the thorax from some heavy body passing over it It is not infrequently accompanied by rupture of the valves * Death takes place nearly always directly after such an accident, either from the shock to the system or from blood entering the pericardiac cavity freely, and thus interfering with the heart's action

Rupture of the heart

216 Wounds of the heart may result either from an external penetrating agent or from a fractured rib or sternum (or breast-bone) The latter, however, does not take *place so frequently* as the similar accident in the case of the lung, owing to the better protection of the pericardiac cavity in the chest Its consequences, on the other hand, are

Wounds of the heart

* The *valves of the heart* are infoldings of the lining membrane strengthened by a little fibrous tissue they serve to prevent the backward flowing of the blood

much more serious, and for all practical purposes wounds of the heart, whether produced by an external penetrating agent or by fractured bone, may be considered together.

Fatality of cases of wounds of the heart.

217 The wounds are regarded as necessarily fatal, and though a large proportion of them are so, yet recovery takes place in about 10 per cent. As in rupture of the heart, death takes place either immediately from shock, or from blood entering the cavity of the pericardium and so impeding the contraction of the muscular fibre; or secondarily, from the after consequences of the wound. Thus, death may take place from continued hæmorrhage, either externally or into the surrounding tissue, or it may take place as a result of the acute pericarditis and myocarditis * set up by the injury. The nature of the wound does not appear materially to affect the mortality, nor does the part of the heart wounded. Thus, the average of fatality remains nearly equally distributed among punctured, incised, and lacerated wounds, and the same is true whether the right or left cavity† be wounded.

Signs of wound of the heart.

218 The signs of a wound of the heart are the fact of a wound existing in its immediate neighbourhood, the occurrence of external hæmorrhage from it, and the signs of internal hæmorrhage, which may take place either into the pericardial cavity or into one of the mediastinum. The pulse is small, intermittent,‡ and irregular.§ There is often considerable pain over the sternum, and much dyspnœa, though these are not constant. The dyspnœa does not come on immediately, but is generally a late symptom in those who live sufficiently long. Auscultation may reveal a friction

* [illegible]

† [illegible]

‡ [illegible]

§ [illegible]

sound* if the amount of blood in the pericardium be small, but more frequently nothing is audible, the heart sounds being muffled by the surrounding blood †

219 With regard to the cases of rupture of spleen already referred to a case was omitted which has been recorded by Dr Chevers of a soldier who was hit on the left side by a piece of shell, on the day of the final attack upon the Redan He was suffering from "severe pain in the left side, which was augmented by pressure over a circumscribed place, corresponding to a point a little external to the cartilage of the ninth rib, and not more than three inches in circumference, there was anxiety of countenance and accelerated pulse, but no abrasion of the surface, no fractured rib, no swelling or discolouration of the part" He was treated for the symptoms, and discharged two days after at his own request, and, to all appearance, quite well He returned to duty, which he performed, as usual, for two days, when he was re admitted with symptoms of double pleurisy, under which, with pericarditis, he died on the eighteenth day after receiving the blow The peritoneum, throughout its entire extent, was of an almost perfectly black appearance, as well that of the parietes as that of the intestines, the omentum‡ was likewise black, but in no other respect did the peritoneum differ from its healthy character It was still glistening, tense, and elastic The spleen was about three times its ordinary size, ruptured to the extent of two inches in its long axis, and to a considerable depth in its anterior and external aspect Its substance was infiltrated with congealed and black blood the vessels were uninjured There was no fractured rib and no laceration of the parietal peritoneum

Case of rupture of spleen recorded by Chevers.

220 The question, of how long a man can survive and what exertion he is capable of going through after receiving

Period of survival in case of rupture of spleen

* *Friction sound* is a term here denoting a soft grazing noise of a to and fro character due to the two layers of the pericardium rubbing against one another

† HEATH's *Dictionary of Practical Surgery* Vol *I* p 659

‡ The *omentum* is a part of the peritoneum forming a sheet like covering for the intestines

the injury, may frequently arise in the course of a criminal trial, and once came before Mr Gribble in the course of a magisterial enquiry into a rather typical case for this country (see Illustrative Case No XLVIII) There seems to be no doubt that no definite rule can be laid down and a man with a ruptured spleen might be quite capable of walking and yet eventually die of the rupture

Mutilation as a punishment

221 Under Hindoo law, mutilation of every portion of the body is authorized as a punishment for certain offences, for instance, hand or foot, both hands, one hand and one foot, both hands and both feet, buttock, lip, penis, half the penis, testicles, pudenda,* fundament, ears, nose, breaking the teeth, finger or fingers, pulling out the eyes, &c Mutilation, as a punishment, appears to have been prevalent throughout Asia, and is practised in China to the present day Amongst the lower classes, cases of mutilation, such as cutting off the nose, the hand or an ear, are by no means uncommon, and occur generally on account of quarrels or jealousy regarding a woman Gouging the eyes also occurs, and in former days the usual punishment inflicted upon royal princes who were guilty of rebellion was to deprive them of sight by passing a red hot needle through their eyes Gholam Khader gouged out the eyes of the Emperor Shah Alam, with his own dagger, and throughout the pages of Indian history numerous instances of this kind of punishment are to be found Mutilation of the testicles is an exceedingly common offence, but it occurs generally in combination with some other injury, such as strangulation The testicles are sometimes cut off, but more generally squeezed In 1870 a case came before Mr Gribble, as head assistant magistrate, in which the district moonsiff of Sholinghur was charged with having abetted the torture of a Brahmin boy, who was suspected of having stolen a jewel Amongst other tortures inflicted to make him confess, it was proved that the sharp pointed leaf of the date bush was pushed up the urethra and that

* Those parts of the female generative organs visible externally

it was likewise used for puncturing the testicles Considerable injuries were found on these parts by Dr Silas Scudder, and the moonsiff together with several others, was committed to the Sessions Court and convicted

222 It is almost impossible for a medical witness to say whether or not a fracture has been caused by a particular weapon, and very often it is exceedingly difficult to state whether a fracture has been caused by a blow or by an accidental fall Of course, when there are other attendant signs he may be able to give an opinion that the fracture was caused by a blow There are, however, so many cases of severe fractures occurring from falls whilst walking or in falling from a short height, that each case must, to a certain extent, depend upon its own circumstances The bones vary in brittleness at different ages and in different individuals, and skulls vary much in thickness, being occasionally so thin as to be fractured by a slight blow With children and with old persons, a slip and fall, whilst walking, is capable of producing a fracture I have known a family in which three of the children at different times fractured an arm or a leg by a simple fall whilst playing, and I have seen another case in which a gentleman of about thirty years of age fractured his skull by falling down whilst rising from his chair, it is supposed that at the time when he rose he was suddenly seized with an apoplectic fit, but he was in sound health five minutes before the fall The mere presence of a fracture, without any other suspicious signs, is no proof of criminal violence it may be due entirely to accident Difficulty in deciding cause of fracture

223 All medical jurisprudents agree that it is much more difficult to cause a fracture after death, even a short time after death has occurred, than is the case during life time As soon as death has occurred, the flesh and the muscles lose their elasticity, and it requires much more violence to cause a fracture after than before death A fracture during life is also generally accompanied by an effusion of blood around the broken parts and though it is by Fractures during life and after death

no means impossible for bleeding to result from a blow caused soon after death, it is not likely In the case of a fracture, where the parts show no signs of bleeding, there would, however, arise an irresistible presumption that it had been caused after death

Fractures as affecting locomotion

224 Mr Gribble heard it asserted by a medical witness, that a man whose rib has been fractured would not be able to walk a considerable distance afterwards This, however, depends entirely upon how the rib has been broken, and whether, in its displacement, it has damaged any vital organ He also met with the case of a gentleman who, in a fall during a steeple chase, broke a rib, and afterwards *remounted and finished the race, and did not find out until* the third day that his rib had been broken Such cases, however, are not by any means uncommon Dr Hehir has met with a case of fracture of two ribs as the result of a violent bronchitic cough, and that of an old Indian officer *who fractured the neck of the thigh bone from turning* suddenly in bed There is a case reported in the newspapers of a well known sporting nobleman in India, who broke his collar-bone at a fall, but continued the race without knowing what had occurred The mere breaking of a bone, or the dislocation of a joint, unless, of course, in one of the lower limbs, need not necessarily interfere with locomotion If it occurs during excitement, the injury is sometimes not felt until the excitement has passed over, unless the displacement of the bone directly affects a vital organ

Gunshot wounds

225 These wounds come under the order of contused wounds, but differ from others in the fact that the vitality of the parts struck is destroyed, leading ultimately to sloughing Casper, whose recorded experience is unrivalled, says *that no one such wound resembles another* In one case we have such a mangling of the countenance, that the body can be no longer thereby recognized, in another, there is nothing to be seen on the body except a small insignificant wound, and that too, in some out of the-way part, such as

the axilla* or popliteal region,† and yet both are gun shot wounds It is possible to lay down but few generally applicable criteria in regard to such wounds, and according to our experience, these few are the following —Every gun shot wound, which is not a mere grazing wound of the skin is either *perforating* (and we have a wound of entrance and a wound of exit) or it is *penetrating* (and the shot does not pass through but lodges and makes only one wound) In such cases, it is often a most vain proceeding *to attempt to find* the ball, piece of lead, or shot in the living body, even when such a solid projectile has been employed which is by no means always the case Every gun shot wound has the peculiarity of becoming larger the deeper it goes This is especially the case in rifle bullet wounds Should the ball lodge in any soft part, the cavity in which it is found is often from two to four times the diameter of the wound of entrance

226 As already remarked, the wound of entrance generally appears to be smaller than the bullet which caused the wound The text books generally say that the wound of entrance has its edges inverted and the wound of exit the edges everted, but this Casper affirms to be by no means the case Projectiles travelling at a low velocity, or which become flattened out or broken up after striking, such as " snider ' and express rifle bullets, undoubtedly make an exit much larger than an entrance wound These appearances will depend greatly upon circumstances, and if the person wounded or the part struck, be very fat, owing to the protrusion of fat through the wound of entrance, the edges of it will be found anything but inverted Gun shot wounds of entrance

227 The appearance of a wound from a conical bullet differs greatly from that caused by a round one A conical bullet causes a trifling, unecchymosed, slightly contused Appearance of gun shot wound from conical or round bullet.

* Or armpit

† The region of the "ham" of the leg—behind the knee joint

aperture, not always round, often more triangular, from the appearance of which no one would suspect the amount of destruction to be found inside Should the ball have passed through the body, the aperture of exit is precisely similar, but, just because of these appearances, the greatest caution is recommended in regard to the answers to any queries respecting the apertures of entrance and exit in the case of wounds with conical bullets

Nature of gun shot injury depends upon distance from which gun was fired

228 When the gun has been charged with shot, the nature of the injury depends very much upon the distance the gun was from the body when fired If from a short distance, the wound often resembles that of a bullet, but in that case the body is certain to show a considerable amount of scorching from the gunpowder If there is a complete absence of scorching or of powder branding from the edges of the wound, "we can assume, with some degree of certainty, that the shot came from a distance (more than four feet), and has therefore probably,—or, according to circumstances, with great probability,—been fired by another." But, Casper adds, even in cases of indubitable suicide, he has missed "both of these criteria from the edges of the wounds," so that it is not absolutely certain that, when a person shoots himself, and the weapon is therefore necessarily within four feet of the body, there should be always traces of burn on the edges of the wound

Gun shot wound

229 As regards a body already dead, the same thing has been remarked in the case of gun-shot wounds as has been noticed in the case of blows and fractures "Bullets, half an inch in diameter," says Casper, "fired from a common pistol against any bone, but particularly against the cheek bone, from a distance of only four or five feet, did not penetrate, but rebounded after contusing the soft parts" A bullet fired against the skull of a corpse remained sticking in the aperture and caused no fissure in the bone, which was of the usual thickness This is due to the great power of resistance of dead corporeal tissues "and for this reason, gun shot wounds, even when pur-

posely produced on dead bodies, can never for one instant be confounded with wounds similarly produced during life" The remarks would scarcely apply to the powerful rifles—Express and Martini Henri for instance—of the present day The latter has an initial forward velocity of 1443 feet per second, and an initial velocity of rotation is 744 revolutions per second At a distance of 25 yards, it is capable of penetrating 14½ elm planks, of half an inch in thickness, placed one behind another, one inch apart

Premeditation defined in case of gun shot wounds

230 Cases of gun shot wounds are rare in Indian medical jurisprudence, but when they do occur, the question of premeditation may be settled by the distance from which the shot has been fired It is manifest that a shot fired from a considerable distance could not have been fired in the heat of a sudden quarrel It by no means follows that a shot fired from a short distance must necessarily traverse the body This will depend to a great extent on the weapon, the form of the bullet, the strength of the charge, and the capability of resistance of the part struck In cases of persons who have committed suicide by putting the pistol into the mouth and firing it off, the bullet has been found lodged in the cranium

Curious case of suicide by pistol shot

231 Dr Hehir came across a curious and interesting case of suicide by a pistol shot, in which the patient attempted to "blow out his brains" by placing the mouth of the weapon beneath the chin He recovered apparently and left the hospital but returned a week later, gradually became comatose, and died in a few days after the second admission into hospital At the *post mortem* examination the bullet was found at the base of the brain The brain and its membranes were intensely inflamed

Presumption in case of gun shot wound in temple or mouth

232 A gun shot wound in the temple or the mouth is calculated to raise a presumption of suicide, but is not proof of it, for those parts might be selected by a murderer in order to avert suspicion An interesting case of doubtful murder or suicide in gun shot wound has already been

and the appearances on dissection, showed also that death had not resulted from the injury received, since it could not have produced such an ulcer, particularly on the opposite side, and if the blow had only completed the perforation of the ulcer, the symptoms which came on subsequently must of necessity have instantaneously presented themselves

CASE No XLVIII —WHAT WAS THE CAUSE OF DEATH ?

THE following very typical case of a mysterious death occurred in Cuddapah in 1879, when Mr Gribble was acting as district magistrate —

The tahsildar of S —— had gone to a village to collect arrears of revenue One of the ryots, on being brought before the tahsildar, was no doubt impertinent The man seems to have been a quarrelsome fellow, and, the tahsildar said, made a threatening gesture At all events, the tahsildar struck him with his stick and ordered him to be taken away, and whilst he was in the act of going, gave him a poke with the end of the stick in the *right* side The man was taken to a tope in the village, and his hands were tied behind his back Whilst seated on the ground, a gumastah, or clerk passed by, and saying What, are you the man who would strike our tahsildar? kicked him in the right side The man fell over on his side and exclaimed 'Ayo'! The man was kept there during the day and ate only a portion of the food brought him In the evening he was marched off to the subsidiary jail, about ten miles off On the way he was twice attacked with bleeding from the mouth and nose The blood from the mouth contained clots From the time of his arrival in jail he was ill, and refused food He was groaning constantly, and on the following morning bled from the nose and mouth For two days more he eat no food On the fourth day he eat a little rice and pepperwater; and the fifth day he was insensible, and died on the morning of the sixth day During this time deceased complained frequently of pain in the right side, breathed hurriedly and with difficulty, did not sleep and was always moaning Directly he died he was buried and the death was entered in the jail register as one of fever Just before his death, deceased had a few convulsive twitchings and an evacuation, otherwise he had been constipated After complaint had been made, the body was exhumed, but was then described as being too decomposed to admit of a *post mortem* examination. The zillah surgeon, who was present during the enquiry, gave it as his opinion, that deceased had not died from rupture of any internal organ, such as the spleen liver, or fracture of the ribs but, it being proved that he was a passionate man had in the excitement of the altercation, probably ruptured a blood-vessel of the lungs which accounted for his bringing up blood by the nose and mouth, and subsequent congestion and sub-acute inflammation, and [illegible] of the lung, aggravated no doubt by extreme mental anxiety starvation and want of proper treatment. The kick on his right side could not in my opinion have ruptured the liver; if it did so death would have been instantaneous On the other hand, if it only injured the organ, the [illegible] result would have been inflammation, which is

invariably accompanied by jaundice, high temperature, tympanites,* diarrhœa, or obstinate constipation, and other acute and specific symptoms." It was also considered, that if a rib had been broken by the kick or the blow, deceased could not have walked ten miles (*sic*), and if the kick had ruptured the spleen, death would have been instantaneous (?) Under these circumstances, as no Court would, in the face of this medical evidence have convicted of homicide, this charge was not pressed, and the matter was otherwise dealt with The cases cited here would seem to show that with the exception of a wound in the spinal cord above the third cervical vertebra† (and of course paralysing the legs), locomotion, even for a considerable distance, is possible with *almost any description of wound!* In this case the body was exhumed about fourteen days after the death, and it is somewhat difficult to understand why the decomposition should have been so considerable as to prevent an autopsy. Of course, in the first instance, all the subordinates had combined to hush the matter up

Case No. XLIX —Recovery from cut throat.

A rather singular case of this kind occurred in Madanapally in 1876 The notes of the case were kindly supplied by Mr. Ward, the medical officer —

On the 8th April, a man, after killing his wife and another man, attempted to commit suicide He was found by the medical officer at about 3 A.M. lying on his back on a heap of rubbish, with his throat cut "There was no hæmorrhage at the time, but he had evidently lost much blood, and was almost pulseless; he rallied after a while, and was removed to the hospital; * * * it was found that the larynx had been completely cut across at its upper part, and the pharynx divided, the cut extending so much on each side as almost to expose the main vessels (carotid, &c) The parts were brought together with silk sutures, and nourishment administered per rectum. * * *. For a few days the case seemed to progress favourably, but it soon became evident that the man was sinking from want of sufficient nourishment and water. * * *. The sutures had cut through, and, except a slight healing and contraction of the wound, generally no

* Distension of the abdomen produced by flatulence

† In 1883 a case was tried in October before Mr C A Bird, acting judge of Chittoor, in which a man was found guilty of having killed his brother in a quarrel Deceased's skull was fractured, and a portion of the brain protruded, and yet he was able to walk upwards of a mile to his house, where he died!

Surgeon Major Browne related a case that occurred within his experience in Madras, in March 1884 A native stoker was struck by an iron bucket, in which the ashes were

effect was produced. The man was therefore fed through the wound, as attempts to pass a tube through the mouth caused a good deal of irritation * * * 3rd July.—Patient is in good condition; operated this morning by freshening the edges of the parts above and below and brought them together by internal and external sutures, (enemata of milk, eggs and broth), * * * 9th July.—The sutures have all cut through, but the wound does not gape as much as before * * * Attempts to bring the edges of the wound in the larynx together—after the cut in the pharynx had healed—caused much distress; it was only after tracheotomy was performed, and a tube kept in, that the wound in the larynx was partially closed after repeated operations. The man was able to speak with difficulty by closing the opening in his larynx with his fingers. In April 1877, twelve months after the attempt at suicide, he was sent to the sessions court at Gujranwala, where on 5th May he was tried and convicted for the double murder. *Sentence*—Transportation for life.

CASE No. L.—RECOVERY FROM CUT THROAT.

CHEVERS quotes a case in which a man with the carotid artery divided* survived till the following day. It appeared that a man was aroused in the night by two thieves who were in the act of stealing in his house. In the struggle which ensued one of them cut him in the neck and they escaped. After receiving the cut he said that he had seen the prisoners who had been stealing his *goor*,† that he had seized one of them, and that the other cut him on the neck with a *dhao* or knife, and both made their escape. The accused not having come with the neighbours were sent for and confronted with the wounded man, who accused them as above. The man's brother stated that the occurrence happened late at night, and that it was then moonlight. The man died the *following day*. The civil surgeon's evidence was as follows: 'I found an irregular deep wound on the neck, apparently caused by a sharp-pointed instrument; the wound in my opinion was not caused by the man's own hand; the *carotid artery was divided*, and deceased had bled to death.' It is to be regretted in this case that it is not recorded whether it was the *external* or the common carotid artery that was divided. If it was the latter Chevers says that this is the only recorded case of so long a survival; but TAYLOR (ed. of 1883, Vol. I., p. 631) says: 'There are several cases on record which show that wounds involving the common carotid artery and its branches, as well as the internal jugular vein, do not prevent a person from exercising voluntary power, and even running a certain distance,' for instance.

CASE No. LI.—RECOVERY FROM CUT THROAT.

In 1863 a man committed suicide by cutting his throat. The external carotid artery and the internal jugular vein‡ on the right side were cut

* Medical Jurisprudence in India p 427.

† Gour or Jaggery is the coarse sugar of the country.

‡ The innominate veins, one being situated on each side of the windpipe, are the largest veins in the neck.

through and a large quantity of blood was lost. The wound extended from the front of the angle of the right jaw to near the windpipe, which was not wounded The man survived half an hour, but was speechless and insensible. (*Taylor*, Vol I, p 631)

CASE No —LII —RECOVERY FROM CUT THROAT

IN 1831 a woman received a wound whilst in bed, involving the right carotid artery, internal jugular vein, and windpipe Her body was found in the next room, so that after receiving the wound she had got up from bed and had run about six feet *

As regards articulation with a cut throat, opinions differ Chevers quotes a case (p 420) of a man who spoke incoherently, see also case quoted *ante* p 105 But note case from *Tellicherry* in March 1885, in which the statement that a man with the carotid artery severed had been able to name the murderer, was not credited Here again, however, it was not stated which carotid had been divided It would seem to be certain that whereas a division of the external carotid does not always cause immediate death, a division of the common carotid, almost invariably does so, and certainly prevents all articulation In connection with this subject, see the remarkable case quoted in the *Pioneer* of 6th February 1890, in which the judge held that a man who had a wound in his throat "three inches long on the right side, being directed downwards and slightly inwards, dividing all the soft structures (muscles, &c), down to the vertebral column, and both the right carotid artery and the jugular vein and the long nerve cords it had divided the 4th cervical vertebra, but the spinal cord was uninjured"—could, a considerable time after the wound had been caused, have made a long statement The deceased's child wife was accused of having murdered her husband, the jury found her not guilty, but the judge (24 Pergunnahs) differing, submitted the case to the Revisional Bench It then transpired that the police had suppressed the first information sent to them, and as there was good reason to believe that the alleged deposition was a concoction, the accused was discharged

CASE No LIII —RECOVERY FROM CUT THROAT

IN Rex v Danks (Warwick, 1832), deceased after receiving a wound, which divided the carotid artery, the principal branches of the external carotid, and the jugular veins, was able to go twenty three yards and climb over a gate, the time required for such a performance being (as afterwards tested) from fifteen to twenty seconds —(Taylor, ibid).

* For other cases of cut throat, see—
Reg v Edmonds, Swansea, Lent, 1863
Reg v Cass, Carlisle Sum Ass, 1860
Case of Earl of Essex, 1683, found dead in the Tower,
Reg v Heywood, Liverpool, Wint Ass, 1855

CASE No. LIV.—GOUGING OUT THE EYES.

In 1854, a very brutal case was tried at Mangalore, in which the paramour of a married woman, becoming tired of her or jealous, gouged out her eyes with a curved knife and a needle. The woman recovered.—(*Foujdaree Udalut*, 1854)

CHEVERS gives a case of a man who gouged out both the eyes of his wife with his fingers, and otherwise maltreated her, because she declined to have connection with him, being very young.

IN Macnaghten's Reports (*Vol. II*, 427), a case is given of a man who, having tied the hands and feet of his wife, threw her down, sat upon her breast, and put out her eyes with a heated iron.

IN the case of bodies found exposed in the fields or jungle, it should be remembered that the *eyes* are generally the parts first attacked by birds of prey.

SECTION II.—DEATHS FROM VIOLENCE SUICIDAL AND HOMICIDAL

CHAPTER I.

DROWNING

Statistics of deaths from violence—Causes of suicides in India—Asphyxia—Drowning—External appearances in cases of drowning—Abrasions and wounds on bodies after death from drowning—Resumé of external appearances of drowned body—Liquid blood in cases of drowning—Internal appearances after death by drowning—The heart after death by drowning—The brain after death by drowning—Abstract of external and internal appearances present in cases of death by drowning—Summary of proofs of death by drowning—Death before submersion—Condition of drowned bodies when examined—Resumé of *post mortem* appearances in body of drowned—Accidental death and suicides—Mode of death in cases of drowning—Percentage of unmixed asphyxia in cases of drowning—Statistics of suicides and accidental deaths—Mr Gribble's article in the *Madras Times*—Mr Gribble's article in the *Madras Times* continued—Mr Gribble's article in the *Madras Times* continued—Statistics of accidental deaths in Madras—Treatment of the drowned—Method of restoring animal heat—Methods of artificial respiration—Howard's method of artificial respiration—Sylvester's *method of artificial respiration—Marshall Hall's method of artificial respiration*

"IN England about 87 5 per cent of the deaths from violence (= about 6 per 1000 of population) are due to accident, the male death rate from accidental violence being rather more than three times as great as the corresponding female rate In India, as far as can be gathered from published statistics, the death rate from accidental violence equals about 3 to 4 per 1000 of population, the male rate in most provinces slightly exceeding the female rate In India the most common causes of death from accidental violence are drowning, snake-bite, and injuries inflicted by wild animals In the Bombay Presidency, for example, in 1883, accidental drowning accounted for about one third of the total deaths from violence of the year, Statistics of deaths from violence

and in West Indian Provinces about one fourth to one third of the violent deaths occurring yearly are reported as due to snake bite and wild beasts *

Causes of suicides in India

236 Of the causes leading to suicide in India, the following deserve special mention, either from the frequency with which they give rise to cases, or on account of their peculiar character —

(1) *Grief or shame* —This is a frequent cause of suicide Numerous instances are recorded of suicide by wives after quarrels, sometimes trifling in character, with their husbands or their husbands' relatives Pregnancy following illicit intercourse —a not uncommon result of enforced widowhood —has also in many recorded cases led to suicide from shame and distress and even to homicide In the case of males, more or less common causes of mental distress leading to suicide are domestic quarrels and pecuniary losses Instances are also met with of suicide from distress of mind arising from arrest on criminal charges

(2) *Physical suffering* —CHEVERS, MCLEOD, and others, notice that severe physical especially abdominal, pain, is a frequent more or less direct cause of suicide, particularly among females

(3) *Revenge* —Cases are sometimes met with in which an individual who has been injured by another kills himself under the idea that he thereby throws the responsibility for his death on the person who has injured him Instances quoted by Chevers show that under the name of *chandi*, this form of suicide was a well known custom among the ancient Rajpoots A variety of this description of suicide is the practice known as sitting *dharna*, or starving oneself at the door of an enemy or debtor Again, Chevers mentions a case of a man

* LYON s *Medical Jurisprudence for India* 2nd Ed , p 30

at Singapore who cut his throat at his neighbour's door in order to get him hanged

(4) *Religion* —Self-destruction from religious motives were formerly of somewhat frequent occurrence. *One variety of this form of suicide consisted* in the individual offering himself as a sacrifice, in order to propitiate one of the Hindu deities, as, for example, by *cutting* himself under the wheels of the car of Juggernauth, or throwing himself in the Ganges. No doubt, also, in some cases of *sati*, or burning of widows on the funeral pile of their husbands, formerly of frequent occurrence in India, the victim was a consenting party *

237. Under the head of *asphyxia* are included all forms of death in which the act of respiration is primarily arrested, as, for instance, death from drowning, hanging, suffocation, and throttling † Asphyxia

238 The cause of death in *Drowning* is the same as that in strangulation, and most of the internal appearances are therefore similar In cases of drowning, fresh air is prevented from entering the lungs, by the water which has been inspired, and the blood in the lungs becomes imperfectly aerated. There is no longer any supply of oxygen, and the blood circulates in a state unfitted for the preservation of life The action of the heart becomes gradually weaker until at last it ceases, and then the person asphyxiated dies The action of the heart, however, often continues for some time after asphyxiation has taken place It is only after all action of the heart has ceased that recovery becomes impossible In strangulation the process is exactly Drowning

* Lyon's *Medical Jurisprudence for India*, pp 31, 32

the same The ligature round the throat compressing the trachea or windpipe, prevents the supply of fresh air to the lungs, and death follows in the same manner In investigating a case of alleged drowning, the following considerations may be of use —

(a) Previous history of persons found in the water,—any alleged suicidal tendency, or any motive that would render suicide probable

(b) Height from which the person fell

(c) Absence or presence of signs of death from drowning

(d) Absence of stakes or other objects in the water that might have caused injuries to any one falling against them

External appearances in cases of drowning

239 The "goose skin" or *cutis anserina*, is considered by CASPER to be a sure sign of death by drowning This appearance, however, is only to be found when the body has been a few hours in the water, and when the inspection takes place immediately after its removal When this contraction of the skin is found, it is strongly presumptive that the person must have been alive when he entered the water, but it must be remembered, as pointed out by Taylor, that this condition is met with after death from any sudden shock, *e g*, after death from hanging In cases of drowning, the face is pale and calm, with a placid expression, the eyes are half open, the eyelids livid, and the pupils dilated, the mouth closed or half open, the tongue swollen and congested, *sometimes marked by the teeth* (CHEVERS and GUY say, rarely), and the lips and nostrils are covered with a mucous froth Casper speaks of a remarkable contraction of the penis in males who have gone into the water living and states that he has not met with this same condition of that organ after any other form of death

Abrasions and wounds on bodies after death from drowning

240 Abrasions and wounds are often found on bodies which have died from drowning Frequently these marks are the result of accidental injury at the time of immersion

or to injury after immersion Abrasions may be caused by the person having come in contact with the bottom, or, in the case of wells, by having come in contact with the sides in falling In the same way, wounds may be caused by any part of the body, especially the head, coming in contact with any hard substance whilst in the act of falling A body found in the water with a wound on it is naturally calculated to excite a suspicion of violence having been employed, and caution should be exercised before giving an opinion that the wound was caused before immersion The fact of the edges of the wound having commenced to contract is not necessarily proof that the wound was caused before immersion, because this would be the case if the wound was caused in the act of falling, or at any time before or immediately after death It will, to a great extent, depend upon the internal appearances as to whether it can *be said that the wound was caused before or in the act of* immersion If the internal organs present none of the ordinary appearances of death by drowning, and there is a wound in itself likely to have caused death, it would seem almost certain that the wound had been caused some time before immersion, and that the body was already dead when placed in the water Of course, in the case of a stab or a gun shot wound, there could never be any doubt, but the case is different when there is a contused wound, say, of the head, which has produced a fracture in itself likely to have caused death It often occurs that the hands are found clenched and contain aquatic weeds, gravel, &c This is a highly suggestive sign that the body came into the water alive, but care should be taken to ascertain whether the weeds are the same as those growing *in* the water, and whether the gravel is the same as that found at the bottom

241 The following *resume* of the external appearances found in the body of the drowned may be read with interest — Resumé of external appearances of drowned body

(1) *In the Skin* —The presence of "goose skin"—*cutis anserina*—is hardly ever absent, even in summer

The *cutis anserina* is not, however, characteristic of drowning, as it may be present in other forms of violent death, and also in some persons during life It is a vital act, the result of nervous shock, and does not depend upon the temperature of the water for its production, still it points to recent vitality

(2) *The Tongue* —"The tongue is just as often found behind the jaws as between them" (CASPER)

(3) *The Hands and Feet* —The hands and feet acquire a greyish blue colour when the body has lain in the water from twelve to twenty four hours The skin also becomes corrugated in longitudinal folds The greyish blue condition of the hand is known as the "cholera hand" The nails may contain particles of sand and weeds "No corrugation or discoloration of the skin of the hands or feet is ever observed on the body of any one drowned, who has been taken out of the water within half an hour, or sometimes even within two, six, or even eight hours" (CASPER) The same authority states that he has produced these effects by laying the hands after death in water, or wrapping them in cloths kept constantly wet for some days

(4) *The Genitals* —Contraction of the penis is an almost constant symptom, and, as has been stated above, Casper has "not observed anything similar so constantly after any other kind of death" It is due, probably, to the same cause as the *cutis anserina*, which Brettner attributes to "bundles of unstriped muscular fibres, lying in the upper stratum of the true skin, surrounding the sebaceous glands, and forcing them forwards by their contraction, thus making the *cutis anserina* Precisely similar unstriped muscles

are found in the sub-cutaneous cellular tissue of the penis, they run principally parallel to the long axis of the member, but very often large bundles run across it " The action of cold and fright is to induce contraction of these cutaneous muscles, with a resulting contraction of the penis

242 A very important point to be observed in deaths by drowning is the liquid character of the blood This is held by some authors to be almost the only certain sign of death by this cause This symptom, however, is not invariably found, and all that can be said of it, from a jurisprudent's point of view, is, that its absence, combined with the absence of other symptoms one would expect to find, is calculated to raise a suspicion of death from some other cause

Liquid blood in cases of drowning

243. The lungs will be generally found greatly distended and filling the whole of the cavity of the chest, they will be flabby in appearance, and an impression made on them by the finger will be preserved, which is owing to their having lost their elasticity from being penetrated by water and they will be three or four times their ordinary weight owing to the same cause On incision, a bloody, frothy, liquid escapes The windpipe, *bronchi*,* and the minute air tubes of the lungs, will be filled with the same kind of mucous froth, but this appearance is not always met with, and depends probably upon the amount of struggles the deceased went through in his endeavours to breathe Taylor says "The presence of mucous froth in the air passages may be regarded as a characteristic of asphyxia by drowning When discovered in the lungs, associated with a watery condition of these organs, it furnishes a satisfactory proof of this mode of death " If, however, the inspection is not made soon, i e, two or three hours after death, this froth may entirely disappear It sometimes

Internal appearances after death by drowning

* The two primary tubes into which the windpipe divides

of India, however, cut their nails (unless they have taken a vow not to do so) to the quick, and hence in almost all their bodies this appearance was absent

(3) *Retraction of the penis* —In 28 cases in which notes were made regarding this condition, in 16 or 57 14 per cent the penis was found retracted

II —INTERNAL APPEARANCES —

(1) *Condition of the lungs* —Of the 305 cases of drowning under consideration, 278 or 91 1 per cent were congested, 5 or 1 6 per cent were healthy, and in 22 or 7 2 per cent I was unable to find any note regarding this condition

(2) *Position of the lungs* —Of the 305 cases of drowning, in 41 or 13 4 per cent the lungs were large, overlapped the heart, and were boggy to the touch, in 6 or 1 9 per cent they were large and spongy to the touch, in 18 or 5 9 per cent they were large, in 12 or 3 9 per cent the lungs filled half the pleural cavities, in 5 5 or 1 8 per cent they were collapsed, and 173 or 56 7 per cent no notes were kept

(3) *Contents of the bronchi and air cells of the lungs* —In 282 or 92 4 per cent frothy sanguinous fluid was found in the bronchi and air cells of the lungs, in 1 or 3 per cent, in addition to the fluid, mud was ascertained to be present in the pulmonary bronchi and air cells, and in 22 or 7 2 per cent no note was made

(4) *Heart* —Of the 285 cases noted, in 142 or 49 82 per cent dark fluid blood was found in the right side of the heart only, in 1 case or 35 per cent it was found in only the left side of this organ, in 17 or 5 95 per cent in both sides of the heart, but more in the right than in the left side, in 125 or 43 85 per cent the heart was empty owing to putrefaction, but in these cases the endocardium of the right side of the heart was stained a dark colour, showing that blood had been there, but had been expelled by the gases of putrefaction

(5) *Condition of the stomach.*—In these 305 cases of drowning in 281 or 92.1 per cent. this viscus was found to be healthy; in 5 or 1.6 per cent. it was congested, and in 19 or 6.2 per cent. no note could be found.

(6) *Contents of the stomach.*—Of these 305 cases, in 131 or 42.9 per cent. the stomach contained food, in 51 or 16.7 per cent. fluid, in 11 or 3.6 per cent. both food and fluid, in 3 or 9 per cent. weeds as well as fluid were present, in 2 or 6 per cent. mud as well as fluid, in 2 or 6 per cent. only mud, in 69 or 22.6 per cent. it was empty, and in 36 or 11.8 per cent. no notes were kept.

(7) *Condition of the small intestines.*—In these 305 cases of drowning, in 260 or 85.2 per cent. the small intestines were found to be healthy, in 18 or 5.9 per cent. they were congested, and in 27 or 8.8 no notes were kept.

(8) *Contents of the small intestines.*—In 99 or 32.4 per cent. they contained fæces, in 97 or 31.8 per cent. they were empty, in 27 or 8.8 per cent. they contained fluid, in 11 or 3.6 per cent. bile, in 7 or 2.2 per cent. round worms, in 4 or 1.3 per cent. undigested food, in 1 or 3 per cent. mud, in 1 or 3 per cent. they contained fluid as well as round worms and in 58 or 19 per cent. no notes were made.

(9) *Condition of the large intestines.*—In 272 or 89.1 per cent. they were healthy, 5 or 1.6 per cent. they were congested, and in 28 or 9.1 per cent. no notes were taken.

(10) *Contents of the large intestines.*—In 197 or 64.5 per cent. they contained fæces, in 3 or 9 per cent. fluid, in 1 or 3 per cent. fluid as well as undigested food, in 1 or 3 per cent. mud, in 40 or 13.1 per cent. they were empty, and in 63 or 20.6 per cent. no notes were retained.

(11) *Bladder.*—In 229 cases notes were kept regarding this viscus and in 227 or 99.1 per cent. it was found to be healthy and in 2 or 8 per cent. it was found to be congested.

(12) *Brain*—Notes were retained in 290 cases, in 157 or 54 13 per cent this organ was decomposed or pulpy from putrefaction, in 110 or 37 93 per cent it was normal, in 21 or 7 24 per cent it was soft from putrefaction, and in 2 or 6 per cent the brain was found to be congested

(13) *Vessels of the brain*—Of 282 subjects in which notes were made 268 or 95 per cent they were found to be congested, in 13 or 4 6 per cent they were normal, and in 1 case or 3 per cent there was also extravasation of fluid blood over the surface of the brain

(14) *Condition of the œsophagus*—Notes were retained in 65 cases in 60 or 92 3 per cent it was found to be healthy, and in 5 or 7 6 per cent it was congested

(15) *Contents of the œsophagus*—Of the 65 cases, in 1 or 1 5 per cent mud was present, in 1 or 1 5 per cent grass, in 1 or 1 5 per cent food, in 38 or 58 4 per cent it was empty, and in 24 or 36 9 per cent no notes were kept

(16) *Condition of the larynx, trachea, and bronchi*—Of the 305 cases in 80 or 26 2 per cent their mucous membranes were congested, in 8 or 2 6 per cent they were healthy, and in 217 or 71 1 per cent no notes were kept

(17) *Contents of the larynx, trachea, and bronchi*—Of the 305 cases in 26 or 8 5 per cent frothy mucus was found, in 9 or 2 9 per cent mud was present, in 1 or 3 per cent mud and straw, in 4 or 1 3 per cent fluid was found, in 1 or 3 per cent mud and frothy mucus were present, in 2 or 6 per cent food from the stomach had passed into the air passages, in 19 or 6 2 per cent they were empty"

Summary of proofs of death by drowning

247 To sum up, TAYLOR states that the internal appearances upon which medical jurists chiefly rely as proofs of death from drowning, are—first, water in the stomach, and, secondly, water with a mucous froth in the air passages and lungs As regards water in the stomach, Chevers very rightly points out that its presence may be due to the deceased having drunk water shortly before he met his

death. If the water is salt, and the body is found in salt water, this would not apply; or, if the water is of a peculiar kind, or contains weeds of the same kind as grow in the water where it was found, the presumption would be almost irresistible that the person had died from drowning. In the case of a body found in a well or tank of fresh water with only water in the stomach of a moderate quantity, say, one pint, it by no means follows that death was caused by drowning. Water in the stomach, *together with* the mucous froth in the air passages and lungs, seems to be the only certain test; or, in the absence of water in the stomach, the mucous froth alone might be sufficient to cause a very strong presumption. The quantity of blood in the right ventricle of the heart varies so much, that absolute reliance cannot be placed upon any opinion formed from the absence or presence of blood. The same may be said of the brain; and suffusion* of blood on the brain may have been caused by apoplexy, under the influence of which the deceased may have fallen into the water. As regards water in the lungs, a case is recorded of a boy who died from drowning, in which none of the visible signs commonly attributed to drowning were found, and there was no congestion of any of the viscera. As regards the mucous froth, it must be remembered, that, owing to exposure after having been taken out of the water, or owing to the incautious manner in which the body was handled, as, for instance, with the head downwards, liquid passing out of the lungs may have removed it. As regards external symptoms, great care should be taken in observing the hands when the body is removed, because the fact of their being clenched and containing grass, weeds, or sand, may prove conclusively that the death occurred after submersion, if, as before remarked, such grass, weeds, etc., are similar to those found in the water.

248. In the case of death before submersion, it is very rarely that water finds its way into the stomach after the

Death before submersion

* Suffusion is a term signifying a spreading or flow of any fluid of the body into the surrounding tissue.

body has been placed in the water, but the absence of water from the stomach is not conclusive that death occurred prior to submersion If, after submersion, the drowning man does not rise to the surface, it is exceedingly probable that little or no water will be found in the stomach The water is swallowed when the person rises to the surface and gasps for air, but if asphyxiation takes place below the surface, it is quite possible that no water will be swallowed, since with asphyxiation the power of swallowing ceases This has been ascertained from experiments made upon animals

Condition of drowned bodies when examined

249 Of Dr MacKenzie's 305 cases, in 138 or 45 28 per cent putrefaction was present, in 5 or 1 63 per cent the bodies were saponified, in *124* or 40 65 per cent the bodies were fresh and in the remaining 38 or 12 45 per cent no note was made as to their condition

Resumé of post mortem appearances in body of drowned

250 The *following* is a resume of the internal *post mortem* appearances met with in the body of the drowned —

(1) *The Brain* —Cerebral hyperæmia is *most* rare in the drowned, but cerebral hypostasis* is not infrequently mistaken for it

(2) *The Trachea* —The mucous membrane of the trachea and larynx is always more or less injected,† and is of a cinnabar red which must not be mistaken for the dirty brownish red colour, the result of putrefaction A white froth, but seldom bloody, is also found in varying quantity in the trachea, and is a most important sign of vital reaction, but its diagnostic value is destroyed by putrefaction Sometimes a portion of the contents of the stomach may be found in the trachea When this occurs it is du to act of coughing, induced by the admi of water lungs The contents of the sto oeed mouth, and then drawn into the

* *Vide* ante p 5
† *Injected* here means c

attempt at inspiration This indicates that the person entered the water during life In cases where death has taken place from syncope, little or no froth may be found in the trachea

(3) *The Lungs* —The lungs are completely distended, almost entirely overlapping the heart, and pressing close to the ribs They are spongy to the feel, and when cut into, a considerable quantity of bloody froth escapes The *froth* found in the lungs is the result of the powerful attempts to breathe, and cannot be produced by artificial means It adheres not to the sides of the bronchial tubes, as does the exudation of bronchitis or pneumonia The distension of the lungs is due partly to an actual hyperæmia, partly to inhaled fluid, and partly to hyperæmia

(4) *The heart and great vessels* —As is common to other forms of asphyxia, the left side of the heart is entirely, or almost entirely, empty, the right, on the contrary, is engorged This condition of the heart is, therefore, not a diagnostic sign of drowning, and is absent in the drowned when death takes place by neuro paralysis,* in fact, in some cases of undoubted drowning, both sides have been found empty, probably, however, the result of putrefaction (*Ogston*) The same may be said of the accompanying congestion of the pulmonary artery

(5) *The Blood* —As is common in all forms of death where respiration has been arrested, the blood is found to be remarkably *fluid*, and of a *cherry-juice colour* M Faure, in his monograph on asphyxia, states that he has found large and firm clots in the right side of the heart in the drowned who have not remained long under water

(6) *The Stomach* —Casper considers that the presence of fluid in the stomach, corresponding to that in which the body is found, is '*an irrefragable proof of the actual occurrence of death from drowning*,' and that the swallowing of it

* *Neuro paralysis* here signifies paralysis due to sudden cessation of functions of the vital nerve centres

must have been a vital act of the individual dying in the water

N B—Putrefaction in the drowned in most cases commences in the upper part of the body, and extends downwards The face, head and neck are first attacked This is the reverse of putrefaction in air *

Accidental deaths and suicides

251 The greater number of deaths by drowning occur amongst women, with whom it is a favourite form of suicide, especially in Madras and Bombay This predilection, however, is only natural, since they are the persons who draw water It is also only to be expected, considering the extremely dangerous manner in which women and young girls are to be seen every day standing poised on two out jutting stones, and pulling up a heavy chatty or other utensil of water from a well, that there should be many accidents but still, allowing for all this, there is little doubt that a great number of these reported accidental deaths and suicides are in reality murders It would be a good thing if district magistrates were to issue an order that every case of accidental death or suicide should be sent into the nearest hospital for *post mortem* examination The following hint may be of value to village and police officers, whose duty it is to conduct the first local examinations When a female deliberately commits suicide, she generally takes one end of her cloth, and, passing it between her legs tucks the end into the part round her waist behind This is done from feelings of modesty, lest when the body is found and taken out, her person should be exposed At the same time, it would be dangerous to lay down any rule with reference to the presence or absence of this sign It might however, serve as a clue for further enquiries It is not unfrequent in Northern India to find that suicides have attached weights to their bodies before jumping into the water Chevers mentions several such cases When bodies are found tied hands and feet, or when a heavy weight is attached, a suspicion at once arises that death is due to

* HUSBAND'S *Medical Police*

violence of a homicidal nature rather than to suicide But even in this case no rule can be laid down, because there are two recorded cases of indubitable suicide, in which the deceased, one of whom was a good swimmer, themselves tied their hands and feet so as to insure speedy death In a case of this kind, the first thing that should be done is to examine whether the knots could have possibly been tied by the deceased's teeth As regards many of the symptoms of drowning, it may be said that it is almost impossible to lay down a hard and fast rule regarding any one of them The great thing to be ascertained is, whether the death was caused by, or previous to, the immersion

Percentage of unmixed asphyxia in cases of drowning

252 DEVERGIE, whose experience in cases of drowning is very large, says that the cases of unmixed asphyxia are as two in eight (25 per cent), the cases in which no traces of asphyxia exist, as one in eight (12½ per cent), and the mixed cases as five in eight (62½ per cent) In cases of pure asphyxia, death has been caused by immersion only, in cases where there are no traces of asphyxia, death must have been caused previous to immersion, but even these cases may not be due to criminal violence A person might be seized with apoplexy and tumble into the water dead, or a person accidentally falling into a well from a height might fracture his skull so as to cause instantaneous death before he reached the water These cases are rare, and it may be safely said that when a body is found in a well, with no traces of asphyxia, a very grave suspicion arises of murder having been committed In the remaining 62½ per cent of cases, the causes of death are due partly to asphyxia and partly to other causes, such as disease or injuries The body of a person who had fallen into the water in a fit, *would probably show traces of both apoplexy and drowning*, and, in the same way, a person injuring himself in the act of falling, would probably die, not only from the injuries received, but also from asphyxia Where injuries are found, it should be carefully noted whether such injuries could have been caused in the fall As regards the attacks

the excess amount, or about 600, is probably due to this cause But why is it that the remainder, *viz*, about 1,000 of each sex are accidentally drowned, and why is it that there are so many children drowned, who certainly are not so much employed in drawing water as adults? There is reason to fear that a large proportion of these reported accidental drownings and deaths from snake bite are in reality murders Dr Chevers, in his work on medical jurisprudence, says 'The latter gentleman (Mr Alexander) informed me that when he first went to Chumparun, he was astonished at the number of persons reported daily to have died from drowning The persons so dying were principally women and female children It struck him as suspicious that so many should be carried off daily in this manner He therefore issued positive orders that all bodies should be brought in for *post mortem* examination, upon this, the reports decreased wonderfully He believed that many of the persons reported to have died in this manner had been made away with' In another place he also mentions that a police superintendent having adopted the same tactics in two different districts, it was found that a large proportion of deaths reported to be accidental were, on examination, found to be murders, and convictions were subsequently obtained * A general order of this kind seems to be required in this Presidency Ten years ago it would probably have been impossible to carry such an order out, but now that dispensaries are being established in almost every taluq town, it is feasible, for there is, generally speaking, a medical man within fifteen to twenty miles of every village At present, it is left entirely to the village punchayets to decide as to the cause of death These punchayets are formed of ignorant villagers many of whom may be, perhaps interested in hushing up what is the result of domestic quarrels In *1862*, *Native Surgeon Ruthnum Moodelly*

* In the one district seventy seven prisoners were subsequently charged with murder of thirty seven persons whose deaths had been reported as accidental and in the other out of fifteen deaths reported as accidental ten were proved to be murders

wrote as follows in the *Madras Quarterly Journal of Medical Science* regarding punchayets —'They perform their temporary duty very reluctantly, pay no attention to the proceedings at the inquest, and are glad to get rid of a vexatious task by finding any verdict they please' If there is no medical opinion available, the proceedings are often made use of to extort money If a crime has occurred, the guilty parties probably have to pay smartly for hushing it up, and the profits are shared by the police and the village magistrates Mr Malabari, in his recent eloquent appeal regarding the re-marriage of widows, points out how often the career of a virgin widow ends in shame and crime, and it is to be feared that many a domestic scandal is hushed up by the 'accidental' death of the guilty party Truth, it is said, is at the bottom of a well, and if she would only reveal the secrets she sees down there, the curtain would be raised from over many a tragedy

260 "From the last Administration Report, however, we gather that the actual loss of life from wild beasts was only 139 In calculating the number of snake bites for the districts, we have therefore allowed an average of 100 to each of 19 districts Madras city and the Nilgiris we have omitted, as the circumstances there are exceptional, and Bellary and Anantapoor are taken together Adding, therefore, 100 on account of snake bites to the accidental deaths and suicides by drowning only, we arrive at some very surprising results The districts seem to fall into three groups In the first of these are Vizagapatam, Nellore, Cuddapah, and North Arcot, and in these districts one death in every 30, 30, 33, and 40 respectively, has been ascribed to one of these three causes In the next group there are ten districts, viz, Ganjam, Godaveri, Kristna, Bellary, Chingleput, Madura, Canara, Salem, Coimbatore, and Kurnool, where the deaths from these causes range from 1 in 47 to 1 in 56 In the last group there are only five districts, viz, S Arcot, Tanjore, Trichinopoly, Tinnevelly, and Malabar, where the proportion of deaths from these causes varies from 1 in 64

M Gribble's article in the *Madras Times*—continued

to 1 in 128 of the total deaths from all causes Now, it is rather remarkable to notice from these figures that in those districts which most abound in water and wells, the deaths from drowning are of less frequent occurrence than in the inland districts As regards snakes, we fancy that in reality pretty nearly every district is the same, but we find a very remarkable difference in the figures reported Unfortunately, deaths from wild beasts are lumped together with snake bite, though probably in some districts, such as Chingleput, Tanjore, and Trichinopoly, there are very few deaths from wild beasts In Chingleput 95 deaths are reported, in Tanjore 185, and in Trichinopoly 169, whilst in S Arcot there are no less than 200 In Ganjam, Vizagapatam, and the Godaveri, where there should be a large number of snakes and wild animals, only 68, 67, and 87 deaths from this cause are reported In Cuddapah there were 132, and in the neighbouring district of Bellary there were, over a larger extent of country, with about the same population, only 73 deaths The difference between Cuddapah and Bellary, as regards deaths from drowning and suicides, is also remarkable, when it is remembered that the circumstances of both districts are very similar In Cuddapah, in 1883, there were 382 accidental and 89 suicidal deaths, whilst in Bellary there were only 240 and 70, respectively In every district the accidental deaths are greatly in excess of the suicides but it is remarkable, that in the thickly populated districts the suicides are far less than in the poorer ones, where the population is thinner Thus, in Tanjore, there were only 4 suicides, but 249 accidental deaths from drowning, in South Arcot, 21 and 294, in Trichinopoly, 12 and 246, and in Malabar, 16 and 386, respectively The highest number of suicides is reported from the Godaveri, Kistna, and Coimbatore districts, where there were 122, 107, and 106 Another strange thing is, that whereas in most districts the figures are pretty nearly the same one year after another, in others there are most extraordinary variations For instance, in North Arcot there were, in 1882, no less than 641 accidental deaths from

drowning, whilst in the following year there were only 528 In Coimbatore, on the other hand, there were 365 deaths from the same cause in 1882, but 436 in the next year

261. "When the figures of the up-country districts are compared with those of Madras city, we again find some striking differences Whereas in Madras the proportion of accidents and suicides to the population is at the ratio of 1 in 8282, in almost all the districts the average ratio is far greater Tanjore alone is somewhat better than Madras, the ratio there being 1 in 8420 Ganjam comes next with 1 in 7776, but we cannot help suspecting there must be something wrong in the reports of this district, for all the rest are far behind The worst is Cuddapah with 1 in 2167, and Nellore and Coimbatore come next These figures go to show that there is grave reason for supposing that a large number of the reported accidental deaths, suicides, and snake-bites are in reality homicides Steps should be taken to sift this question thoroughly " *Mr Gribble's article in the Madras Times—concluded*

The following remarks from *The Lancet* on the increase of suicide may be interesting

262 "There seems no doubt that a notable increase of cases of suicide is in progress among civilised nations Comparative statistics are hard to obtain, and are often open to question, but that the present century has witnessed a steadily increasing proclivity to suicide in Europe seems indisputable A recent writer computes the suicides of Europe at 60,000 annually, and believes that while this number represents the recognised cases of suicide, we should require to double it in order to reach the true figure, and to include secret or unrecognised cases Germany affords the largest relative proportion of cases, France and England follow next in this order, while Spain, Ireland, and Portugal are very little given to suicide The Sclavonic race is the least suicidal in Europe As a general rule, suicide is relatively more frequent among the civilised *The Lancet on increase of suicide*

and cultured than among the ignorant and barbarous The list of notable suicides is a long one, and includes men in the very front rank of literature, science, art, politics, and war

Cases of suicide

263 "The causes of suicide are numerous and obscure Probably no question opens up more diverse or more abstruse problems in sociology than the inquiry into the reasons that tend to make men weary of life Racial idiosyncrasy (itself a very obscure subject, and capable no doubt of further analysis), degree and quality of the civilisation attained, type of intellectual development, religion, the severity of the struggle for existence, disease—all these play their part in determining whether a larger or a smaller proportion of persons of unstable brains will elect, "to bear the ills they have" or, "fly to others that they know not of" Alcoholism is alleged to be the chief obvious cause of suicide in Northern Europe, but before we can admit this doctrine we should require to investigate the causes of alcoholism itself, to determine how far it is itself a symptom of nervous instability, or an index of misery, over pressure, or boredom No error in sociological inquiry has been more widespread or pernicious than the tendency to accept alcoholism as an ultimate fact, requiring no further explanation or analysis, and to trace to the fact of alcoholism all the deplorable evils which follow in its train, without regard to the pre disposing causes or the associated conditions The same hereditary or racial peculiarities that incline one individual to alcoholism *minus* suicide may incline another to alcoholism *plus* suicide

Effects of destitution on suicide

264 "It is very striking that absolute want and destitution do not seem to be frequent causes of suicide The abjectly poor and the utterly ignorant do not in any considerable numbers seek to terminate their misery by self destruction To incline to suicide there would seem to be required a sharp disparity between either the present and the past social condition of the individual or between his desires and his attainments The hereditary or chronic

pauper, however miserable his state, rarely thinks of violently terminating his sufferings, probably because he has become accustomed to them, or has only a vague realisation of the difference between what is and what might be. On the other hand the man who has fallen from comfort and social consideration to utter need is in danger, because he vividly realises the contrast between the present and the past Somewhat parallel is the fact that it is the more intellectually gifted races that are most prone to seek refuge in suicide The intellectual German or the sprightly Frenchman incline to self destruction, whereas the phlegmatic Slav has no such inclination It is in this connection that the very unwelcome fact of the tendency of education and culture to increase the proclivity to suicide finds its explanation Education, while immeasurably increasing the usefulness and enlarging the enjoyments of the individual, also multiplies his wants, and if those wants cannot be reasonably satisfied, irritation and unrest ensue and may pre dispose to suicide We must recognise this fact, and it need occasion no surprise The man whose mind has expanded by science, art, or letters cannot be satisfied by ignorant Hodge with a hunk of bread and cheese, a pipe, and a quart pot The former has aspirations which cannot be stifled without danger, and the gratification of which may be beneficial not only to himself, but to his fellows The enormous benefit of education is that the new wants which it creates are in the main intellectual, and that their legitimate satisfaction tends to wean the individual from the gratification of the senses The conclusion to be drawn is not that the perils of education outweigh or even seriously detract from its advantages, but that as education spreads adequate provision must be made for the satisfaction of those new wants which this spread involves

265 "We are apt to attribute the growing tendency to suicide to the nervous wear and tear of an age of over-pressure, to the railway, the steamboat, the post, the Over pressure as a cause of suicide

Method of restoring animal heat

268 The *first* of these indications is carried out by covering the patient with blankets or flannels, applying hot bottles on the feet, legs, loins, and arm pits The second by applying a mustard plaister over the region of the heart—or better a hot mustard poultice—and rubbing the limbs upwards, that is, towards the heart, and giving the patient small doses of some volatile or alcoholic stimulant The nervous system may be roused by stimulants, or electricity, or flagellation with a wet towel Secondary mischief may be prevented by watching the patient carefully for a few days, and attending at once to any inflammatory complication arising in internal organs

Methods of artificial respiration

269 There are three chief ways of carrying out *artificial respiration,—Howard's, Sylvester's, and Marshall* Hall s, named in their order of merit

Howard's method of artificial respiration

270 *Howard's direct method* is employed as follows —(*a*) Instantly turn the patient's face downwards with a large *firm roll of clothing under the stomach and chest* Press with your weight two or three times, for four or five seconds, each time, upon the patient's back, so that the water is pressed out of the lungs and stomach, and drains feebly downwards out of the mouth Then (*b*) quickly turn the patient face upwards, the roll of clothing being now put under his back just below the shoulder blades, the head hanging back as low as possible, place the patient's hands together above his head, kneel with the patient's hips between your knees, fix your elbows against your hips Now, grasping the lower part of the patient's chest, squeeze the two sides together, pressing gradually forwards with all your weight for about three seconds until your mouth is nearly over the mouth of the patient, then, with a push, suddenly jerk yourself backwards Rest about three seconds, then begin again Repeat these bellows blowing movements, so that the air may be sucked into the lungs about eight or ten times a minute Remember, the above directions must be used on the spot, the instant the patient

is taken from the water A moment's delay and success may be hopeless As soon as the water is pressed from the lungs all clothing should be ripped away from the chest and throat In making the pressure either for the removal of the water or for breathing, increase it gradually and thoroughly, and suddenly let go with a jerk With women and children use less force Do not stop these movements under an hour unless the patient breathes Be careful not to interrupt the first short natural breaths If they be long apart, carefully continue between them the bellows blowing movements as before

Sylvester's method of artificial respiration

271 *Sylvester's method* —Grasp the patient's arms above the elbow and pull them upwards until they meet above the head, this has the effect of causing the air to enter the lungs and imitates natural inspiration Next bring the arms back to the sides, and repeat this upward and downward movement about fifteen or sixteen times in a minute, and continue doing so until the patient breathes naturally or all hopes of his recovery are gone

Marshall Hall's method of artificial respiration

272 *Marshall Hall's method* —This method is easy to carry out but less efficient than either of the foregoing, although certain authorities have recently claimed for it a superiority over all other methods The body is rolled half over—from the position of lying on the back—to that of lying on the side, when the arm which is uppermost is pulled forwards out of the way, and pressure is made on the side of the chest to expel as much air as possible This corresponds with the expiratory movement The body is then rolled over on the back (the inspiratory movement), and these movements are repeated at the same rate as in Sylvester's method

273 Artificial respiration has been successful after five hours apparently suspended animation When breathing is properly established, cover the patient with warm clothes, particularly warm blankets

ILLUSTRATIVE CASES.

CASE No LV.—MISTAKEN CASE OF DROWNING

CHEVERS gives the following remarkable case of mistaken *post mortem* signs, which shows how cautious a medical man should be before committing himself to an opinion Dr. Woodford, at Calcutta, made a *post mortem* examination of the body of a European sailor at the police dead house He found the clothes saturated with water Sanious froth was round the nostrils the hands were somewhat soddened, but the boots, which were wet, had preserved the feet It was twenty four hours after death, and decomposition was advancing rapidly. The skin was vesicated and the body covered with particles of sand The vessels of the brain and the right side of the heart were engorged* with blood The lungs and other viscera were highly congested He certified that deceased died from submersion in water The coroner returned the certificate for explanation, as the police reported that the deceased had died in the police lock up from apoplexy. The clear explanation was, that the body had been carried from the lock up to the dead house, a very small godown, with open windows, only three feet from the ground It was placed on a table under a window on the west side rain had fallen in torrents all night, and the wind blew from the west. Dr Woodford found the body on a table in the centre of the room The clothes were, as we have seen, saturated, and the body was covered with particles of sand (Dr. Woodford observes that, in Bengal, drowned bodies, which have not been disturbed, are invariably covered with particles of fine sand) The sand had been driven on to the body by the rain from the loose plaster at the upper part of the window cornice Chevers remarks ' Thus all the usual external appearances of drowning presented themselves, and the internal morbid appearances were simulated by those of apoplectic death " It seems, however, that in this case two important internal symptoms were wanting, which should have led Dr Woodford to make further enquiries, viz, the absence of any water in the stomach or lungs, and the absence of mucous froth in the lungs or air vessels If a person had been drowned and had presented the internal symptoms recorded, it is exceedingly improbable, though not impossible, that there should have been no water in the stomach and lungs and no mucous froth in the air vessels The fact of mucous froth round the nostrils should have shown that the water could not have escaped from the stomach, and cleared the air-vesicles, by rough handling of the body The above case is very interesting as showing what care is needed in a *post mortem* examination of bodies found drowned, and how little confidence can be placed upon the superficial signs.

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* That is, over-distended with blood, vascular congestion.

CASE No LVI —ANOTHER DOUBTFUL CASE OF DROWNING

CASPER gives the case of a man found drowned ten weeks after he had been missed He had gone to discharge some rent due, and the receipt was found in his pocket, but a document which it was known he had taken with him was missing The body was, of course, extremely putrefied, the eyes staring and the tongue firmly wedged between the teeth On the left side of the throat there was a whitish depressed mark, two lines broad The lungs were much distended left side of heart empty, and the right filled with blood, which was rather dark and treacly The trachea still contained a small quantity of bloody froth No water was found there, or in the lungs or stomach The brain had become converted into a bloody pap, and could not be examined The skull bones, however, were uninjured The duodenum* and œsophagus (or food pipe) were chemically examined, but showed no trace of poison "We gave it as our opinion (1) that deceased had died from asphyxia; (2) that it was possible, and indeed probable, that this had been occasioned by drowning, (3) that the high degree of putrefaction in which the body was, prevented any certain conclusions being drawn from the mark found upon the neck, (4) that, supposing death to have been caused by drowning, it cannot be determined, with any degree of probability, whether it has been a case of homicide, suicide, or accident" After several months the missing document was found, and further judicial investigations placed it beyond doubt, that in this case the death from drowning had been suicidal

CASE No LVII —ANOTHER CASE OF DROWNING

IN the following case, quoted by Casper, of an epileptic, who was found drowned with his face in a shallow turf pit, we give, as an example, the *verbatim* "minute of the examination" This is a document upon which, in Germany, great stress is laid, and the report itself will show with what care the examination was conducted, and how *every point of importance* is touched upon —

A —External Inspection

(1) The body is five feet five inches in length, apparently about forty years old, well nourished; has an abundance of light brown hair, the eyes are blue, and the tongue lies behind the teeth The tongue is covered with mud, particularly towards its point

(2) *Rigor mortis* does not exist

(3) The colour of the body is the usual corpse colour, only the abdomen is green from putrefaction, and the whole countenance red from *post mortem* staining, proved to be such by incisions †

(4) About the middle of the forehead there are two spots situate one above the other, of a reddish brown colour inclining to yellow,

* The *duodenum* is the first part of the small intestines, being continuous above with the stomach

† The deceased was found dead, lying on his face and with it half immersed in a shallow muddy puddle close to the bank.

hard to cut, roundish in form, and about three-quarters of an inch in diameter Incision through these spots brought to light no extravasation of blood

(5) The ridge of the nose displayed the same condition already described under No 4

(6) The posterior surface of the upper extremities, several parts of the face, also the back of the body, are soiled with mud

(7) The hands and feet are bluish, and both, but particularly the former, display longitudinal corrugations, especially on the fingers

(8) The skin on the inferior extremities and on the right arm displayed the condition termed *cutis anserina* or "goose skin"

(9) No foreign bodies are found in the natural cavities, with the exception of some mud removed from the fauces

(10) At the external angle of the left eye, after removal of the mud, a dark bluish red coloration of the upper and under eyelids became visible, which, when incised, betrayed a trifling extravasation

(11) The neck and sexual parts are natural, and there appears nothing else to remark on the external surface of the body

B —Internal Inspection

I —*Opening of the Cranial Cavity*

(12) The soft parts covering the cranium display nothing unusual The skull bones are uninjured, and are of the unusual thickness of three lines

(13) The vascular meninges* display a visible, but not extraordinary, degree of congestion

(14) The brain is firm, but not much congested

(15) The lateral ventricles† are tolerably well filled with serum, the choroid plexuses‡ tolerably congested

(16) The cerebellum§ is quite normal

(17) This is also the case with the pons Varolii and the medulla oblongata

(18) All the sinuses‖ are much congested

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* The *meninges* are the membranes covering the brain and spinal cord; here those of the brain being referred to

† The *ventricles* of the brain are spaces formed in that organ during its development. The *lateral ventricles* are two in number situated one on each side deep in the brain substance and are formed by the upper part of the general ventricular space in the interior of the brain

‡ The *choroid plexuses* are dense vascular networks in the lateral ventricles of the brain

§ The *cerebellum* is the inferior part of the brain lying below the cerebrum

‖ The sinuses of the skull are large venous canals having their walls in the majority of cases formed partly by the bones themselves

(19) The *basis cranii* (or bones forming the base of the skull) is uninjured and there is nothing else to remark in regard to the cranial cavity

II.—*Opening of the Thorax*

(20) All the organs are in their natural position The right lung is partially connected to the ribs by means of old adhesions, both lungs are darker in colour than usual, completely filling the thoracic cavity and are very full of blood, without being excessively so There is no water in the lungs

(21) The large blood vessels are also not unusually congested

(22) In the pericardium* there is the usual quantity of fluid The coronary† vessels of the heart are very strongly congested, and the right side of that organ is turgid with dark and perfectly fluid blood, while the left is empty

(23) The trachea (or windpipe) and larynx‡ are empty and in no respect abnormal, muddy mucous flows downwards from above during the examination

(24) The œsophagus is empty

(25) In the left pleural cavity there are about three ounces of bloody fluid

III —*Opening of the Abdominal Cavity*

(26) All the organs occupy their natural positions The stomach is full of a greenish yellow watery fluid, in which the remains of food and some mud can be recognized, in other respects it is normal

(27) The pancreas is normal

(28) The liver is strongly congested with dark fluid blood, the gall bladder is full

(29) There is nothing remarkable about the spleen

(30) The mesenteries§ and omenta§ are very fatty

(31) The kidneys are much congested

(32) In regard to the intestines we have only to remark that the large one is full of fæcal matter

(33) The urinary bladder is empty

(34) The *vena cava ascendens*‖ is tolerably distended, with dark fluid blood

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* The pericardium is the tough fibrous and serous membrane which cov[ers] the heart

At the close of the dissection, the medical inspectors gave it as their opinion —

(1) That the deceased had died from apoplexy of the heart and lungs

(2) That death had occurred in a muddy fluid,

(3) That the deceased must, therefore, have been alive when he fell into the water

(4) In answer to a question the ecchymosis of the left eye, described under No 10, is not to be regarded as a cause of death.

r.	a	s *	
(Signed) Casper		(Signed) Lütke	
a	u	s †	
Jordan		Bidault ‡	

The *report* of the examination is, in Germany, a different document, and contains the opinion of the doctors, based on the facts elicited by the examination We give *in extenso* the report of the same case —

Medico-legal report in the matter of the inquiry respecting the mode of death of H

II 3 52 §

"In conformity with the directions of the Royal District Commission of Charlottenburg, dated the 5th of this month, and referring to the above-mentioned inquiry, we have the honour to transmit to you the following document, constituting the medico legal report required —

"According to report,‖ H, who had been for many years afflicted with epilepsy, disappeared upon a certain day, his body being soon thereafter found lying close to the bank of a turf pit near Charlottenburg; he was reported to have been robbed, and therefore a medico legal examination was rendered necessary The dissection was performed by the subscribing medical inspectors, on the 26th of March, with the following results":—

A —External Examination

(Here follows, word for word, the report of the anatomical appearances as given above, to which is added the following opinion:)

"In our provisional opinion we have assumed as probable that the deceased had fallen into the water alive, and therein met his death, that he consequently was drowned, and we must still maintain this view For not only were the signs of every other species of unnatural death awanting, since the trifling ecchymosis described under No 10, being in no way connected with any important organ, could have had no influence whatever in

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* Read over—approved—signed The German letters are v g u :—Vorgelesen, genehmigt, unterschrieben

† *Actum ut supra*

‡ These are the signatures of the legal official present, and of the sworn clerk who drew up the minute

§ The reference numerals of the corresponding documents

‖ In this case no documents were given us, only a copy of the minute of the dissection

producing death, and the marks upon the forehead and nose (mentioned under Nos. 4 and 5) were very probably made after death, and were at any rate of no importance whatever; but the results of the dissection also revealed the existence in the body of most of the appearances usually found in those drowned. Amongst these, medico-legal experience enables us to reckon the bluish coloration and wrinkled condition of the skin upon the hands and feet (7),—which of themselves, however, only prove that the body must have lain some time in the water—the so-called *cutis anserina*, which was quite distinct in certain parts of the body (8), the mud found in the fauces* (9), and along with those external appearances of the body, the *corresponding* internal ones, which taken together, are extremely demonstrative, viz., the visible congestion of the cerebral membranes (13), and of all the cerebral sinuses (18), the congestion of the lungs (20), of the coronary vessels of the heart, and of the right side of the heart itself (22), the remarkable distension of the lungs (20), the congestion of the liver and kidneys (23 and 31), and the fluidity of the blood in the body generally (22 and 34), which, as well as the appearances found in the stomach, must be regarded as particularly important symptoms. The stomach was distended with a watery fluid, in which were distinctly visible isolated particles of mud (26), precisely similar to that which we found upon the tongue and in the fauces, from which it incontestably follows that the deceased must have swallowed after falling into this muddy fluid, must, therefore, have been alive, since water cannot flow into the stomach after death; consequently, it cannot possibly be supposed that the deceased was already dead when he fell into the water, and this view is also supported by the other existing appearances symptomatic of death by drowning. The deceased has in fact died from apoplexy of the heart (asphyxia), like a great many of those that die in the water, has consequently been drowned. Had we been asked whether the deceased had committed suicide or met with his death accidentally or by the fault of a third party, we must have stated, that the dissection revealed neither proof nor probability of there being any third party criminally concerned with the death (by violently throwing the man, while still alive, into the puddle), while, contrariwise, it is a most probable supposition that H. met with his death in the water by suicide or accident, having been suddenly seized with an epileptic fit, for instance, while standing by the edge of the water, and so fallen in and been drowned. Should it really be found, which we know not, that the deceased has been found robbed, and close to the bank, this would in nowise militate against our view, for it is self-evident that nothing could be more likely than that a third party, seeing the body floating in the pool or lying near its bank, should drag it ashore and plunder it.†

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* The *fauces* is the space surrounded by the palate, tonsils and uvula or little tongue.

† It afterwards appeared that there was not the slightest trace of any crime committed on the drowned man. What might not, however, have been made of this case in the medico-legal report by means of a few judicious doubts and forced interpretations! (*Note by Dr. Casper.*)

"We accordingly declare it to be our opinion, that H has fallen into the water alive, and died in it from drowning —Berlin, 19th April 1852

"Casper (Official seal) "Luthe chir for (Official seal)"

CASE No LVIII —DEATH FROM DROWNING CAUSED BY EPILEPSY

OGSTON gives a case of a man who was seized with an epileptic fit whilst leaving a privy, and fell with his face in some dirty water, which was contained in a space not exceeding a foot and a half in breadth, with a depth of only three or four inches

Another case is quoted by Taylor, as given by Devergie, in which a man was found drowned in a small stream, his face towards the ground and his head just covered by water, which was not more than a foot in depth On dissection there were all the appearances of drowning present, and a large quantity of sand and gravel was found occupying the windpipe and smaller air tubes

CASE No LIX —ANOTHER CASE OF DROWNING

The following case is from Chevers, and shows how the nature of the water and substance found in the stomach may lead to the detection of crime —The body of a child was found in a tank at a considerable distance from his own house and suspicion was naturally excited that he had been conveyed thither and made away with Dissection afforded clear evidence of death from drowning the fauces larynx, and trachea contained small portions of green vegetable matter, and the right bronchus was almost completely filled with so large a portion of an aquatic weed, doubled together, that it appeared astonishing how any such body could pass the *rima* * It was afterwards proved distinctly that no weed of the kind grew in the tank where the body was found Further enquiry led to the discovery that the boy s body had been found by a woman in a tank near his home, in which the weed, lodged in the air passages grew abundantly This female had conveyed the corpse to the more distant tank which belonged to a person against whom she bore a grudge † A similar case is to be found in *Reg* v *Thornton*, Warwick Summer Assizes, 1817

* The *rima*, *rima glottidis* or chink of the glottis, is the opening at the top of the larynx

† For further cases of asphyxia drowning, consult—

Reg v Cowper (London Law Magazine Vol X (State Trials)

Reg v George Hereford L Ass, 1847

Reg v Barker York Winter Ass 1846 (state of blood in cases of drowning)

Reg v Griffin Tailor, Vol II page 24

CHAPTER II.

HANGING AND STRANGULATION

Cause of death—Apoplexy or asphyx a—Dr MacKei zie s stat stics of cases of l n gi g—Ju licial l anging—Mark of ligature on tl e neck—Hanging usually due to su cide—P i ts to be noted when l an e l body first dis covered—The S iriyana Kovil case of alleged su ci le—Necess ty for noti g every appearance at first exai ination f a body—Case f Mal abir charged with i irdei—Deta ls to be observe l i cases of alleged sui ide—I missio i of seme i a l fæces—Stia gl i g—Deatl by strang ilat o without marks f i juries—Death can be ca ise l by l an i g without bo ly bei g suspei de l—Statistics of inco i lete hai ging—Cord sh ll be exa n ed in cases of ha ged bodies—Warn th of body important evi lence—External a pearances in death by l ang ng—In ternal a pearai ces in death by l anging—Case of n ur ler by suffoca tion—Death by strai gulation—Differei t modes of strang ilatio i—Throttling—Marks on the tl ro t in death by epilepsy—M rk roui d the i eck may be due to hy ostasis—Statistics of *post i ortem* conditions in ci ses of death by su ci le—Nat ire of cord used by s icides—Remarks on above cited cases of suicide—Outl i es for examinatio i and i spection of bodies in cases of hai ging or stiai gul iti n

WHEN death is caused by hanging, there has been more or less perfect suspension of the body by a cord applied round the neck, the weight of the body being the constricting force, but in strangulation the constricting force is due to some other cause If the constricting force is so great as to prevent any air reaching the lungs, death results from asphyxia, if, however, owing to the looseness of the cord, or its position round the neck, a small quantity of air can reach the lungs, then death is caused, not by asphyxia, but by interruption of the circulation of blood to the brain, owing to the compression of the great vessels of the neck In this case apoplexy is the immediate cause of death *Of course, in a great many cases, death* may be caused by a combination of both asphyxia and apoplexy Cause of death

Apoplexy or asphyxia.

274. The following table, given by Taylor, shows the results at which Casper and Remer arrived from the examination of a large number of cases —

	Remer	Casper
Apoplexy	9	9
Asphyxia	6	14
Mixed conditions	68	62
	83	85

Dr MacKenzie's statistics of cases of hanging

275 We would make the following quotation from the record of Dr MacKenzie's investigations —

"I think it may prove interesting to record my experience of the cases of hanging which have occurred in the largest city in India, extending over a period of about nine years I give the principal facts regarding the cases which came under my observation during this time —

"I had to examine 130 cases of hanging sent to me by the police during this period, of these 65 were males and 65 females, they were all adults and adolescents Of these 130 cases, 127 were natives—64 females and 63 males, the remaining three were—one European male, one Chinaman, and one East Indian female, they were all suicides The causes assigned for these persons taking their lives were as follows —

Family disagreement	38
Ill-health	35
No reason assigned	24
Drunkenness	9
Insanity	9
Poverty	4
False accusations	2
Found in possession of counterfeit coins	2
Remorse at having lead immoral lives	2
Grief on account of the death of a near relation	1

Serious illness of a child	1
Disappointment in love	1
Jealousy	1
Theft	1
	130

"Of these 130 cases no less than 119 or 91 54 per cent died from asphyxia, 8 or 6 15 per cent from asphyxia as well as apoplexy, 2 or 1 53 per cent from syncope, and 1 or 76 per cent from apoplexy"

276 In cases of judicial hanging, it often occurs that the vertebræ of the neck are dislocated, but it has been observed by Hammond, an American writer, that any extra violence used for the purpose of causing this dislocation is wrong, useless, and barbarous The dislocation does not cause death, and only inflicts unnecessary pain In hanging,—death being caused by asphyxia or apoplexy, or both,—the object should be to produce immediate asphyxia, by adjusting the noose so as to close the windpipe at once Hammond considers that the most effectual way is to adjust the rope whilst the criminal is standing, and then to raise him from the ground In the case of persons weighing under 150 lbs, he recommends that a weight should be attached to the feet, so as to insure sufficient traction of the cord Judicial hanging

277 It is commonly considered, by persons who have not studied the subject, that in cases of death by hanging, there must necessarily be a strongly developed mark of the ligature round the neck, this, however, is by no means the case In cases of judicial hanging, where much violence is used, the mark of the ligature may be found, and there is often ecchymosis of the neck, but in suicidal hanging there is often no mark at all to be found Out of seventy-one cases examined by Casper, there was no mark whatsoever in fifty, on the other hand, Casper has found that the mark round the neck can be produced by suspension Mark of ligature on the neck

after death The conclusion generally arrived at is, that it is rare to find ecchymoses in the mark on the neck, and Casper considers that it is nothing more than a cadaveric appearance, and that it may become livid or dark coloured after death, just as lividity appears in the dead body during the act of cooling The presence or absence of a mark round the neck is, therefore, no proof, one way or the other, of hanging having taken place during life

Hanging usually due to suicide

278 By far the greater number of cases of hanging is the result of suicide, because so much violence is necessary in hanging, and so much opposition may be expected from the victim, that a murderer does not often have recourse to this means of causing death But because hanging is often the result of suicide, it frequently occurs, especially in this country, that persons are first killed, or rendered unconscious, and then hung up, so as to create an impression of suicide There are numerous cases on record in India in which the body was hung up after death, the murder having been previously perpetrated in other ways Chevers (page 597) quotes many such cases If, however, a body were found hanging with marks of violence—such as blows or wounds—on it, it would at once be suspected that the case could not be one of suicide * Hence, if a murder has been committed, it will generally have been caused by suffocation or strangulation first of all If a person has first been strangled, and then hung up, it follows that the internal symptoms will be exactly the same as they would have been had death been caused by hanging It is, therefore, chiefly from the external symptoms that an opinion can be formed

Points to be noted when hanged body first discovered

279 Bearing this in mind, it is of the most absolute importance that, when the body is first discovered, every sign and symptom should be carefully noted If the body is in a room, the size of the room should be carefully

* The presence of marks of self inflicted mechanical violence on the other hand tends [illegible] hanging

measured the position of the body, with reference to the walls, the length of the rope, the nature of the knots, the state of the hands, any marks on the clothes or the body, etc.

260. A very remarkable case occurred at Combaconum in 1882. A high priest of a *mutt*,* a person of very great sanctity, was found hanging in a cell in the *mutt*. He was in the habit of sleeping alone inside the building, and when found, the outside doors were all locked from the inside. Access could only be obtained by climbing over the building and getting into the open courtyard in the middle. The *mutt* was at a village called Suriyana Kovil, about nine miles from Combaconum. The body was taken down, and the apothecary *from Combaconum was sent for*. He came, inspected the body, and, finding no marks of injury, certified that death had been caused by hanging, and that, in his opinion, the case was one of suicide. No internal *post-mortem* was held. The body was buried, as is usual with persons of the deceased's position, in salt. Owing to various causes, suspicion fell upon certain persons. There was apparently no cause for suicide, except the allegation, that finding certain seminal marks on the front cloth, it was supposed that deceased was suffering from a venereal complaint, and hanged himself from shame. It was also alleged that he was pecuniarily embarrassed. On the other hand, there had been a long standing quarrel between deceased and a rival *mutt*. Deceased was found dead just on the eve of a big festival, to which he had invited a number of persons, and at which an important ceremony was to be performed. Immediately after the death, the people from the rival *mutt* took possession of deceased's property and cloister. Sixteen days after death the body was exhumed in the presence of the zillah surgeon, the

The Suriyana Kovil case of alleged suicide.

superintendent of police, and the magistrate It had been buried in very marshy ground, and, in spite of the salt, was in very advanced state of decomposition Almost the whole of the outer cuticle had peeled off There were some livid marks on the fore part of the legs, on the chest, and on the inside of the hands There was scarcely any mark round the neck The deceased was a tall, stout, and well made man, weighing about 12 to 13 stone No internal examination was possible No notes had been taken of the exact position of the body at the time it was found, the cord, however, had been preserved A lengthened enquiry took place, and the following facts were elicited —The body was found hanging from a bamboo, the ends of which rested on a cornice of the wall which ran round the top of the cell It was hanging from the middle of the bamboo, and was therefore in the middle of the room A ladder was found resting against the wall, and the deceased was supposed to have got on to this ladder, tied the noose round his neck, and then to have thrown himself off The cell was eight feet broad, and the length of the rope, between the neck and the bamboo, was a cubit or two feet The middle of the bamboo would, therefore, be four feet from the side where the ladder was standing and, from the position shown, it would have been impossible for a man standing on it to have tied a rope round the bamboo and then round his neck, without leaving a greater extent of rope than one cubit Again, to show that it was a case of suicide, the witnesses, who found the body, said, that before committing the act, deceased had smeared his hands and fingers with holy ashes, of which there was a box in the room at some distance from the corpse This was supposed to be a last act of devotion, such as is customary just before the death of a person of sanctity, and showed deceased s intention to commit suicide But it was clear that if deceased smeared his fingers of his own act, he must have done so before hanging himself, and if so, it would have been impossible for the ashes to be found, as described on his fingers, after death, because the very

act of tying the knot round the bamboo and round his own neck, would have rubbed them off It was clear that the ashes must have been smeared on the fingers by some third party after death Eventually a man confessed to having taken part in the murder The way it was done was as follows —The prisoner was a servant of the deceased, and said that two other men belonging to the rival *mutt* talked him over and arranged to commit the crime On the night in question, deceased was sleeping in one part of the building, and the servant in another At a given signal, the servant opened one of the doors and let the accomplices in They then went to where the deceased was sleeping One man got on his chest and stuffed a ball of cloth into his mouth, and compressed his throat with the other hand, the second sat upon his legs, and a third held his hands After all struggles had ceased, they fetched a bamboo and a ladder, hung deceased to the bamboo, *and then placed it on the cornice with the ladder* by the side They then smeared the hands with ashes, and two of the murderers went out The third locked the door from the inside, and then climbed over the roof and got away The prisoners were committed to the court of sessions, but, as very often happens, the witnesses, who had to speak to other circumstantial points of evidence, told a great deal too much The prisoners, after a long and careful trial, were acquitted by the judge, but there can be no doubt that in this case a murder had been committed

281 This case is especially interesting as showing how important it is to note every fact at the first examination of the body Any evidence which transpires afterwards is of very little value compared with that first taken Had the fact of the length of the rope and the ashes on the hands been brought at once to the medical man's knowledge, it is probable that his suspicions would have been aroused, and a more careful examination would have been made Of course, as is usual in such cases, it was alleged

Necessity for noting every appearance at first examination of a body

that there were good reasons for hushing the matter up, and that the sub magistrate, police, village authorities, and apothecary were all implicated more or less This, however, was not proved

Case of Mahabir charged with murder

282 For the story of the following very similar case we are indebted to Dr W Hoey, Joint Magistrate of Gonda, Oudh —Mahabir was headman of a village, and in his house lived a daughter of his deceased brother, with whom he is believed to have carried on an intrigue or to have meditated one The woman, Bundela, was the girl's aunt, and had on two or three occasions come and taken the young girl away to a distance in order to secure her an honourable marriage One morning Bundela was found hanging from a tree The village chowkedar reported the matter and an Inspector of Police came to the village and called a punchayet, who found a verdict of suicide The Superintendent of Police was not satisfied and ordered a further enquiry Another Inspector was sent, and, after a long enquiry, procured evidence from the residents of the village to show that Bundela had been murdered the day before her body was found suspended She had come to remove her niece, and Mahabir had entrapped her, killed her, and then carried her body out by night, and hung it from the tree Mahabir was committed to the sessions on a charge of murder, but at the trial the witnesses turned round and contradicted the statements they had made to the Committing Magistrate The Judge ordered an enquiry to be made into the conduct of the police, as the witnesses alleged that their evidence had been extorted and that the original report of suicide was true Mr Hoey was sent out to make the enquiry He found that the branch from which the corpse had been found hanging was from 17 to 18 feet from the ground, and was the lowest branch of the tree The trunk was about 2½ feet in diameter and could not have been climbed without the help of a ladder There were only some 9 inches of cord between the neck of the corpse and the branch No ladder had been found near

the tree, and no support on which Bandela could have stood in order to hang herself It is clear, therefore, that the case could not have been one of suicide, and the report and the *punchayet nama* first sent in, were false The first Inspector was either a fool or a knave The murderer escaped, but the witnesses, who were all Mahabir's relatives or dependents, were convicted of perjury for having given two contradictory statements on oath, the one before the Committing Magistrate and the other before the Judge

283 This case is a very good illustration of the absolute necessity of noticing all details, however trifling In all cases of alleged suicide the height from the ground, the length of rope the way it was fastened, and the distance of the body from the nearest support, *are of the most vital importance* Details to be observed in cases of alleged suicide

284 It is by no means uncommon that, at the time of death by hanging or strangulation, there is an emission of semen and fæces, and to this may be attributed the seminal stains in the above case Many medical jurisprudents say that erection of the penis usually takes place, but it is proved that this is by no means so frequent as to justify the laying down of any rule It has been noticed that there is frequently a discharge of saliva at the time of death, and this might furnish a very important piece of evidence If the saliva has trickled down in front of the body and the clothes, it would seem most probable that, at the time of the discharge, and therefore of the death, the body was *hanging* If, on the other hand, the saliva is found to have trickled out from the corners of the mouth, the body was probably lying down when death was caused, and had been hung up afterwards Emission of semen and *fæces*

285 Strangling gives rise to death from the pressure made on the neck by any form of ligature carried circularly* round the neck Strangling

* In *hanging* the cord is usually placed more obliquely round the neck than in strangling

Death by strangulation without marks of injuries

286 In the Suriyana Kovil case already quoted, it will be seen that death can be caused by strangulation and suffocation, without leaving any marks of injuries The marks possibly caused by compression of the throat, if caused at all, would be afterwards covered by the cord It is possible, in the above case, that the livid marks on the legs, chest, and hands, may have been caused by some injury to the cuticle during the deceased's struggles Being injured, they might have shown livid marks when decomposition set in, but at the same time there may have been no bruise or ecchymosis when the apothecary examined the body The coincidence of these marks, with the position which the several murderers were afterwards described as having taken up, was significant

Death can be caused by hanging without body being suspended

287 Amongst many subordinate magistrates and the police of this country, there is a very mistaken idea that death cannot be caused by hanging, unless the body is actually suspended and the feet are off the ground There are, however, numerous instances in which persons have been found dead from hanging, with the feet on the ground, or with the body in a sitting or kneeling position All that is required to cause death is a sufficient weight on the cord to produce compression of the windpipe or of the important blood vessels of the neck

Statistics of incomplete hanging

288 Tidy quotes a table from Tardieu, giving the results of 261 cases of incomplete hanging in which death resulted —

	Cases
The feet resting on the ground	168
The body in a kneeling posture	42
Ditto extended and lying down	29
Ditto in a sitting position	19
Ditto huddled up (*accroupi*)	3
	261

289 In bodies found partially suspended, attention should be paid to the cord, and its strength should be tested Taylor cites a very important case, in which a woman was found dead in a sitting position, with a narrow tape round her neck hung loosely and singly over a small brass hook, *there was a bruise over the eye,* the windpipe was lacerated, and there was a deep circular mark round the neck, which must have been caused either by suspension or by considerable pressure As far as the tape round the neck was concerned, it was impossible that the body could have been suspended by it because the deceased weighed 120 lbs, while the tape round the neck was found to break with a weight of 49 lbs It was proved that the deceased had been strangled by the hand and by a ligature, and that the tape was afterwards tied so as to create a suspicion of suicide In this case blood marks were also found on the tape where it was tied, whereas there was no blood on the hands of the deceased

Cord should be examined in cases of hanged bodies

290 The warmth of the body may often furnish important evidence In the July sessions at Cuddapah, 1884, a case was tried in which this point would have been of great importance A man had been seen quarrelling with his *concubine early in the morning before sunrise,* and was said to have been seen to strike her with his open hand About half an hour afterwards he was met in the street, and engaged to come and labour He received a small advance, which he took home, and immediately afterwards followed his employer to his work He remained at work for two or three hours, until about 10 o'clock Some one then brought information that his concubine was hanging in his house He at once went home, found her hanging, and, leaving her hanging, went off, he said, to fetch the village magistrate The village magistrate came another way and missed him, and when the man came back, the body had been taken down There was no one to say whether at the time the body was taken down it was warm or cold There were marks of severe injury about the head

Warmth of body important evidence

and face there was a fracture of the skull, and the spleen was described as having been smashed to pieces These injuries could only have been caused after a severe and lengthened struggle, and there could be no doubt that the body had been suspended after death The man was accused of having killed his concubine, but as the blow he was said to have given before sunrise could not have caused the injuries found, all these wounds must have been caused in the half hour preceding the time he was engaged to go to work During this time a quarrel must have taken place, the woman must have died from the injuries and then have been hung up after death There were some other contradictions in the evidence, and the prisoner was acquitted, mainly on the ground that the time did not seem to have been sufficient for all these acts Besides this, if he had really killed and hung up his concubine, it was improbable, when he received an advance, that he should have taken it home to where the body was hanging It was proved that the deceased's father was very angry with her for her immoral life in fact he admitted before the sub magistrate that he "hated her" From the circumstances, it seemed probable that the woman had been killed whilst the accused was at work If however, it could have been proved that, when found, the body was still warm there could have been no doubt that she must have been killed whilst the accused was at work The absolute importance of noting every trifling detail when a body is first found cannot, therefore, be too strongly dwelt upon The omission to record some little circumstance may result in the conviction of an innocent person, or in the escape of a guilty one

External appearances in death by hanging

291 The following are the appearances after death by hanging —The eyes are brilliant and staring, the eyelids open and injected, and the pupils dilated, the tongue, swollen and livid, is forced against the teeth, or more or less protruded from the mouth, and compressed or torn by the contracted jaws, the lips are swollen and the mouth

distorted, and blood, or a bloody froth, hangs about the mouth and nostrils, the arms are stiff, the hands livid, and the fingers so forcibly closed on the palm as to force the nails into the flesh, the convulsions are so violent, as sometimes to cause the expulsion of the contents of the bowels, and to produce erection of the penis, with discharge of the urine, semen, or prostatic* fluid The course of the cord is distinctly indicated by a well marked bruise, and, on dissection, the muscles and ligaments† of the neck are found stretched, bruised, or torn, the windpipe injured, and the inner coats of the carotid arteries are sometimes divided, and more rarely there is a fracture, or *dislocation*,‡ of the cervical vertebræ§ and injury of the medulla ‖ The above description from Guy applies, *it must be remembered, chiefly to bodies that have been* judicially hanged—a process accompanied by considerable violence In case of suicide, these signs are by no means so strongly marked, and the face is far more composed Suicides who have been saved from death, and others who have instituted experiments on themselves, describe the sensations in some cases as pleasurable—a sudden loss of sense and motion, sometimes a deep sleep ushered in by flashes of light, by ocular illusions, and by a roaring in the ears In homicidal cases, however, there are always symptoms of great suffering

292 The internal signs are those of asphyxia, already described, or of apoplexy, or of both The stomach is often found highly congested as regards the mucous membrane, and presents the appearance of an irritant poison having been used In this country, cases have

Internal appearances in death by hanging

* The fluid secreted by a small gland called the *prostate*, which is situated at the neck of the bladder

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§ That is the vertebræ of the neck

‖ *Refers to the medula oblongata* which connects the brain *with the* spinal cord

occurred in which persons who had been poisoned have been hung up after death In conducting an examination, therefore, it must be remembered that this appearance, as of an irritant poison may be due to the hanging only, and an opinion should not, therefore, be formed upon it alone, but only if other traces of poison are also found

Case of murder by suffocation

293 With regard to the case of Campbell, for whose murder by suffocation Burke was hanged, the late Sir Robert Christison remarked, "that the lungs were remarkably free from infiltration, and although the blood in the heart and great vessels, as well as throughout the body, was fluid and black, yet the conviction in the public mind—that a well informed medical man should always be able to detect death by suffocation, simply by an inspection of the body, and without a knowledge of collateral circumstances—is erroneous, and may have the pernicious tendency of throwing inspectors off their guard by leading them to expect strongly-marked appearances in every case of death *by suffocation That such appearances are always very* far from being present, ought to be distinctly understood by every medical man who is required to inspect a body and to give an opinion of the cause of death "

Death by strangulation.

294 In deaths by strangulation, it will be generally found that the marks round the neck are more strongly developed than is the case in suicides by hanging More force is generally used by the murderer, and the injury to the parts is therefore greater It is probable also that a struggle has taken place, and that marks of the struggle will be found on the body This, however, is by no means always the case, especially in this country, where strangling is often effected—as in the case from Combaconum—whilst the victim is asleep When there are two or three concerned in the murder, it is clear that it might be carried out without leaving any marks of violence Strangulation is especially common in this country, where the victim has been concerned in an intrigue with a married woman or

where a wife is suspected of adultery Chevers gives numerous instances of this crime, which, for many centuries, has been so prevalent in India In throttling, death is due to the constant pressure of the fingers on the throat Thuggee is now happily extinct, or occurs but very rarely, *but the traditions of this crime are still firmly rooted in* the minds of the people

295 Strangulation in India is effected in many ways — Different modes of strangulation

(1) By compressing the throat with the hands, assisted also by the knee or foot In these cases, owing to the violence which must be used to effect the purpose, there are sure to be very distinct marks, and it is by no means uncommon to find that the neck has been twisted round and the vertebræ dislocated A remarkable case is quoted of a girl who strangled a boy by compressing his neck She afterwards threw the body into a well

(2) The throat is sometimes compressed by a stick or bamboo The victim in such cases is generally caught lying down, his hands and feet are held by different persons, and another places a bamboo over the throat, pressing both ends on the ground Death by this means is generally slow, and may leave but very faint indications of the way in which it has been caused

(3) Tying the throat with a cord, cloth, or stalk If a cord is used, it is almost certain that it will leave strongly developed marks, but this is by no means the case when a cloth is used If a soft cloth, wrapped in broad folds is thrown round the neck and gradually tightened, it will leave scarcely any marks, especially if at the same time death is aided by stuffing a cloth into the mouth Flexible twigs and stalks are often used for strangling, and Chevers cites several cases of murders by this means

Throttling

296 Throttling by direct compression of the windpipe by the fingers is occasionally a means of committing murder, especially in children Chevers* quotes such a case in a child and another in an adult He likewise refers to several instances in which persons have been hanged whilst living after having been maltreated

Marks on the throat in death by epilepsy

297 In case of death by epilepsy,† it is alleged that the person attacked frequently grasps his own throat, so that after death marks of fingers might be found on the throat and a suspicion of murder be thus raised Chevers mentions the case of a man subject to epileptic fits who died in a brothel, and upon whose neck were found marks of fingers The prostitute he had been with was convicted of murder by the sessions judge, but was released by the High Court on the doubt that the death had been from epilepsy, and that deceased had clutched his own throat An almost exactly similar case was tried at Cuddapah towards the close of 1883 Deceased had been carrying on an intrigue with two females belonging to a wealthy ryot's family, all the male members of which lived together in one enclosure One of the women, with whom he had an intrigue, together with her mother, slept together in a separate hut One night, two of the male members, who were sleeping together, were aroused by the mother They went with her, and immediately came back carrying deceased's body, which they placed in another hut and called the village authorities On examination, marks of fingers were found on the neck There were no other injuries, but a quantity of fæces had been expelled. The medical opinion was that death had been caused by strangulation The two men who were seen carrying the

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* *Medical Jurisprudence for India* p 583

† *Epilepsy* is a disease of the nervous system associated with "fits" in which the patient falls suddenly, hence called "falling sickness" In its fully developed form convulsion attended by complete unconsciousness is the prominent feature During the paroxysm to prevent the patient from injuring himself raise the head gently, loose all constrictions, and protect the tongue by placing a piece of cork, india-rubber or soft wood between the teeth

body were accused of the murder The woman's story was, that she was awoke at night by a noise, and saw the deceased sitting on the ground near the wall of the hut He was making a gurgling noise, and the mother then went to fetch the two sons, who, on coming, found the deceased to be dead On the ground near where the deceased was said to have been sitting, some expelled fæces were found There was no evidence to show that the deceased had been formerly liable to epileptic fits For the prosecution it was urged, that the other woman, with whom deceased had had an intrigue, had told her brothers of this assignation, that they had surprised deceased with their sister, and had strangled him Although the expulsion of fæces is by no means an uncommon symptom of death by hanging and strangulation, it is by no means confined to such cases, but is also found in many other cases of sudden death, as by gun shot wounds, shock, etc If deceased had been surprised with the woman, it was difficult to understand how he could have been taken away and strangled on the ground where the fæces were found, without there being more marks of injury Had the fæces been found on the bed, the prosecution story would have been more credible There was a possibility of deceased having died in a fit, and the action of the accused, in at once sending for the village authorities, was against the presumption that they had been the murderers Giving the prisoners the benefit of the doubt raised, they were acquitted, and though Government were moved to appeal against the acquittal, the Government pleader advised that no appeal should be made

298. The appearance of strangulation, from a mark round the neck, may often be caused by *post mortem* lividity or hypostasis When a body is advanced in decomposition, the neck may become discoloured, so as to exactly simulate the mark caused by a ligature Great care should, therefore, be used before expressing an opinion founded on such a mark, and it should always be remembered that

Mark round the neck may be due to hypostasis

the only test for distinguishing between hypostasis and real ecchymosis is by incision of the part. If this has not been done, no reliance whatever can be placed upon the evidence of the medical witness as to the cause of the mark.

Statistics of *post mortem* conditions in cases of death by suicide

299 The following details, abstracted from *Medico Legal Experiences in Calcutta*, are highly interesting. Dr MacKenzie found that of his 130 cases, in 81 the *position of the tongue* was noted, and in 41, or 50 61 per cent, it was found to be protruded between the teeth but not injured, in 61 cases a note was made as to whether it was bitten, and of these the tongue was found injured in 16 or 26 22 per cent. A note was made in 40 cases regarding the *eyes*, and in 15 or 37 15 per cent the eyes were open and the eye-balls were protruded. In 21 cases *frothy mucus* was looked for around the *mouth* and nostrils, and in 20 or 95 23 per cent it was found, 91 cases were noted regarding two lines of mucus at the angles of the mouth, and it was present in 23 or 25 57 per cent. The condition of the *fingers* was noted in 42 of the persons hanged, and they were found to be flexed or clenched in 17 or 40 47. The condition of the nails was noted in 15 cases, and in every one of them they were found to be of a blue colour. In 92 cases 30 or 32 60 per cent had *vaginal* or *urethral discharges*. Out of 23 cases noted, 8 or 34 78 per cent had discharge of fæces from the rectum. In 8 cases the condition of the penis was noted, and in 3 or 37 50 per cent it was found to be erected. The *hyoid bone* was found *fractured* in 24 cases or 25 80 per cent out of a total of 93 observed. Notes were made regarding the *thyroid cartilage* in 64 persons suspended, and of the cricoid cartilage in 11, and in not one of either set of cases was it found to be fractured. Notes were made in 77 cases regarding the *fracture* and *dislocation of the neck*, and in not a single case was there any injury of the vertebræ. Of the 90 cases in which the *coats of the carotid arteries* were observed, in 31 or 34 44 they were foun[illegible]
ed. In 16 or 51 61 per cent of these 31 c[illegible]

coat, in 4 or 12 90 per cent the middle coats, and in 11 or 35 48 per cent both the internal and middle coats, were ruptured

300 The nature of the cord by means of which these 130 persons committed suicide is as follows —"73 used ropes of various materials and thickness, 30 suspended themselves by means of their dhootes, sarees, or chudders, 25 cases were not noted, one person—a determined suicide —used both a rope and the cloth he wore to destroy himself, and one Brahmin hanged himself by his Brahminical thread" Nature of cord used by suicides

301 Regarding the foregoing facts Dr MacKenzie makes the following remarks —"The above notes point to the fact that in these 130 cases of suicide, family disputes and ill health were the two principal causes The causes of death in the majority of these cases was asphyxia, and not the combined asphyxia and apoplexy which Casper in Germany found to be the most frequent mode of death I regret that the notes regarding some of the prominent appearances in death by hanging were not recorded in every case, but, as far as they have been noted, they are of great interest, especially regarding the appearance of the eyes and eye balls In only 37 15 per cent of the cases noted the eye lids were found to be open and the eye balls protruded It will also be seen from these notes that in not a single case was there a fracture or dislocation of the neck, and I can say from memory that this was the case in every one of the 130 *post mortems* given above The above cases point to the fact that, although fractures of the hyoid bones occurred in 25 80 per cent of cases, not a single case of fracture of the thyroid or cricoid cartilages was found In cases in which a rope was used, the mark on the neck was well defined, indented, and parchment like, while in the cases in which cloth ligatures were used the marks were faint, of a reddish colour, and not parchment like, except in places where the cloth was twisted and where the pressure Remarks on above cited cases of suicide

was great The man who committed suicide by means of his Brahminical thread was a big stout Brahmin He had returned home late at night boisterously drunk, and commenced to abuse his own family and neighbours The family, expecting that he would assault them, locked him out of the house into the outer court-yard, where he entered a cow shed and hanged himself He twisted his Brahminical thread into several ply, and was found suspended off the ground by means of it The mark of the cord round the neck corresponded with the Brahminical thread, it was very narrow and deeply indented into the skin of the neck, which was parchment like in appearance In not one of the 130 cases were the muscles of the neck, the larynx, trachea, or large bronchi injured, and in none of them was there any extravasation beneath the skin of the neck, or blisters above the constriction of the cord"

[*Note* — As the different points of importance have all been discussed in cases quoted in the text no Illustrative Cases are given to this chapter]

Outlines for examination and inspection of bodies in cases of hanging or strangulation

302 The following outlines for the inspection and examination of a body in a case of hanging or strangulation is important in connection with the investigation of such cases —

Suggestive Outline for the Inspection and Examination of bodies in cases of Hanging or Strangulation.

I —It is advisable to have a photograph taken of the body, as well as the furniture and of other articles in the room or place in which the body is found, before anything is touched

II —GENERAL ENQUIRIES—

(a) Was the room locked on the inside, without other possible means of escape ?

(b) Were any fire arms or other weapons, or marks of blood, or signs of struggling, noticed about the room ?

(c) Is the dress of the deceased torn, or the hair disarranged ?

(*d*) Does the dress, etc , indicate any interference with the body after death ?

(*e*) Note the position of the body and the character of the dress worn, (any constricting articles of dress about the neck ?)

(*f*) What is the weight of the deceased ? This is important if a question should arise as to the power of the cord to sustain the ascertained weight

III —NOTES RESPECTING THE LIGATURES USED—

(*a*) If the ligature is still round the neck, carefully note (or better still sketch) its exact position, the number, the character, and the method of tying the knot or knots (that is, whether the tying was the work of a right or left handed person), and the exact position of the knots Remove the cord by cutting so as to leave the knots intact

(*b*) If the ligature has been removed, ask for it

(*c*) Preserve and retain the ligature for evidence It may be needful to compare it, with some material either in the possession of an accused person, or belonging to the deceased, or its possession may be traced to some one else

(*d*) Note the material of which the ligature is composed

(*e*) Do the ends of the ligature appear (if a rope) to have been freshly cut ?

(*f*) Compare the ligature with the impression on the neck

(*g*) Note whether there is any brown line on the ligature, such as might result from perspiration

(*h*) What is the strength (or weight-bearing power) of the ligature by which the body was suspended?*

(*i*) Are there any marks of blood, or of hair or other matters, adherent to the ligature?

IV.—EXTERNAL APPEARANCES—

(*a*) Are there any marks of violence on the deceased, other than those directly caused by the hanging or strangling?

(*b*) By what instrument were these marks (if present) likely to have been inflicted?

(*c*) Are they sufficient in themselves to account for death, or, if not sufficient, are they of such a character that they would induce great weakness from loss of blood?

(*d*) Were they probably accidental, suicidal, or homicidal (*i e*, likely to be caused in a struggle)?

---

* The *strength* of a rope is that of its *weakest* part This may be tested by suspending it (by a loop) from a ring or hook and adding weights till it breaks

The rules often given, such as the following, are useless for small cords [illegible]

way of answering questions as to the strength of cords, etc, is by experiment As some guide to the *comparative* strength of materials, we give the following table of the breaking strain of certain fibres

Fibre	According to De Candolle	According to Labillardière
Flax (*Linum usitatissimum*) .	11·7	1000
Hemp (*Cannabis sativa*) .	16·3	1370
New Zealand Flax (*Phormium tenax*)	23·8	1996
Pita Flax or American Aloe (*Agave Americana*)	7·0	596
Silk	34·0	2894

(e) Note—

(i) *Face* —Pale? Swollen? Placid?

(ii) *Mouth* and *Nostrils* —Foam?

(iii) *Tongue* —Position? Colour? Whether injured or not?

(iv) *Eyes* —Prominent?

(v) *Pupils* —Dilated?

(f) *Neck* —Note—

(i) *Character of Marks* —Presence of a groove? Whether it be complete or not? Colour of the borders of the groove, and of the parts beyond? Marks of fingers, etc?

(ii) *Direction of the Marks* —Whether oblique or not Note the apparent position of the knots

(iii) State of the integuments (or skin) in the furrow

(iv) Any excoriations (or superficial abrasions) or ecchymoses

(g) *Hands* —Bloody? Clenched? Anything in the hands? (Carefully preserve any hair, etc, that may be found grasped or attached)

(h) *Sexual Organs* —(In the male, note if there be spermatic (or seminal) fluid in the urethra or canal of the penis)

V —Internal Appearances—

(a) *Neck* —

(i) Dissect out the mark around the neck, cutting for this purpose through the skin an inch above and an inch below

the mark Note the state of the underlying tissues, the presence of coagula (or blood clots), etc

(ii) The entirety or otherwise of the muscles of the neck?

(iii) Effusion of blood amongst the muscles and ligaments

(iv) Injury to the larynx and trachea

(v) " " ligaments of neck

(vi) " " bones (specially the os hyoides,* atlas and axis)†

(vii) " " inveitebral substance ‡

(viii) " " spinal cord (effusion of blood, etc ?)

(b) *Carotid Arteries*—Condition of inner and middle coats? Whether or not there are extravasations of blood on the walls or within the vessels?

(c) *Brain and Membranes*—Congested? Extent of Vascularity?

(d) *Larynx and Trachea*—Congested? Mucous froth?

(e) *Heart*—Right side full or otherwise?

(f) *Lungs*—Congested? Emphysematous§ patches on the surface? Apoplectic or bloody extravasations in the substance?

---

* The hyoid bone is the small horse shoe shaped bone situated immediately beneath the tongue and above the larynx

† The *atlas* and *axis* are the first and second vertebræ of the spinal column

‡ The cartilaginous material or gristle placed between the vertebræ of the spinal column

§ *Emphysematous* means pertaining to Emphysema bloated swelled Emphysema of the lungs is an abnormal accumulation or collection of air in dilated air cells or in the connective tissue framework of the lungs

(g) *Stomach* —Congested? Presence of food? Presence of poisons (such as opium, etc, given to drug the deceased, or for other purposes)?

(h) Are there any morbid appearances that would account for death, otherwise than by the hanging or strangulation?

(i) Has there been any disposition on the part of the deceased to commit suicide, or is insanity hereditary in the family?

For further cases of *hanging* consult —
Recovery from, MEDICAL TIMES AND GAZETTE, July 1, 1854
Recovery from, LANCET, November 1839 [2 vols
Suicide or homicide from, TARDIEU quoted by TIDY, pp 403, 404, 406,
Murder with appearance of suicide, BECK, 566, TIDY, 404
Case of Sarah Cornell, TIDY, 417, Vol II, BECK, 571.
Case of Calas, BECK, 567, TIDY, 419

Strangulation
Reg v Pinckard, Northampton Lent Ass, TAYLOR, Vol II, 71
Case of Gen. Pichegon, TIDY, 411
Case of Sir Edmundbury Godfry, TIDY, 412 HARGREAVES *State Trials*

the mark Note the state of the underlying tissues, the presence of coagula (or blood clots), etc

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(*v*) „ „ ligaments of neck

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Reg v Pinckard, Northampton Lent Ass, TAYLOR, Vol. II, 71.

Case of Gen Pichegon, TIDY, 441

Case of Sir Edmundbury Godfry, TIDY, 442 HARGREAVES *State Trials*

CHAPTER III.

ASPHYXIA—SUFFOCATION.

Definition of suffocation—Various kinds of smothering—Suicidal suffocation—*Post mortem* appearances in death from suffocation—Homicide by suffocation—Methods of homicidal suffocation—Suicidal strangulation with hair—Suffocation the result of certain diseased states—Smothering by sand—Abnormal causes of smothering.

Definition of suffocation.

SUFFOCATION means the exclusion of fresh air by other means than by external pressure of the throat (trachea). This definition would also include drowning, but the word suffocation is generally understood to imply exclusion of the air by covering the mouth and nostrils only. Tidy mentions, as the earliest instance of this kind of murder, the case as found in 2 Kings, viii, 15. "And it came to pass on the morrow, that he (Hazael) took a thick cloth and dipped it in water, and spread it over his (Benhadad's) face, so that he died, and Hazael reigned in his stead." As a historical case of smothering, the case of the two young princes who were smothered in the Tower by orders of Richard III may be instanced.

Various kinds of smothering.

303. The most frequent cases of smothering in Europe are those of young children, suffocated by overlying. These cases are, however, by no means so common in this country. Cases of suffocation in a crowd are common, and in the case of persons in a state of intoxication, suffocation occasionally happens by a portion of the food or vomit obstructing the throat. In the case of Mrs Gardner, which has already been quoted, although the deceased's throat had been cut, death was actually caused by suffocation, owing to the blood flowing into the air tubes. Children are often suffocated by swallowing hard substances, such as the nipple of a sucking bottle. Grown-up people have been suffocated by swallowing their false teeth during sleep, and Negroes are said to commit suicide by

doubling back their tongues and "swallowing" them (*sic*) Dr Chevers says that a percentage of persons in this country are killed by swallowing living fish This, he says is an accident of by no means unfrequent occurrence amongst fishermen, who go about groping in the water to catch fish It is not necessary that the closure of the air passage should be complete, partial closure is amply sufficient to produce suffocation

Suicidal suffocation

304. Cases of suicidal suffocation are very rare, though there are some recorded cases of determined suicides, who have stuffed a ball of cloth into their *fauces* and so have caused death Suffocation is generally the result of an accident, but it may also be the result of some internal disease, such as the bursting of certain internal abscesses, (*vide* paragraph 309, clauses (*i*) and (*j*)), or of the pressure of a tumour on the trachea

Post mortem appearances in death from suffocation

305 The *post-mortem* appearances in death from suffocation are exactly those of asphyxia and need not be further described Tardieu lays great stress on the existence of *punctiform** sub pleural ecchymoses† ("Tardieu's Spots") as a sign of suffocation They are considered to be due to small effusions of blood, ruptured during efforts at expiration, and are usually to be found at the root, base, and lower margins of the lungs These spots, however, are not an infallible test, because they may not be found in indubitable cases of suffocation, and they have been found in cases of hanging and drowning, they have also been found by Dr Ogston after death from scarlatina, heart disease, apoplexy, pneumonia ‡ pulmonary apoplexy,§ and pulmonary œdema ‖

* Having the shape of minute points or dots

† *Sub pleural ecchymoses* are small patches of a dark red colour lying beneath the pleura or covering of the lung

‡ *Pneumonia* is inflammation of the true substance of the lung

§ *Pulmonary apoplexy* is hæmorrhage into the air cells of the lungs

‖ *Œdema* of the lungs is produced by a serous exudation into its substance

Homicide by suffocation

306 In this country it is probable that many cases of homicide by suffocation occur in the manner described in the Suriyana Kovil case, given in the last chapter, but as probably at the same time violence is used, death will result from other causes, such as strangulation combined with suffocation The Resurrectionists who killed persons in order to sell their bodies for medical examination, applied a plaster over the mouth and nostrils, and, in addition, applied pressure to the chest

Methods of homicidal suffocation

307. Chevers gives numerous instances of homicidal suffocation by filling the mouth with mud, sand, cloth, compressing the chest, and closing or covering the mouth and nostrils In cases of this kind it commonly happens that the victim s testicles are squeezed It is possible that this squeezing accelerates death by the shock caused to the nervous system and by the intense pain, whilst at the same time respiration is obstructed He likewise gives the case of a boy who was throttled by the pressure of the knee on the throat Many instances are recorded of throttling by stamping on the neck with the feet A case is also recorded in which a man assaulted an aged woman, stamped on her neck, strangled, and, at the same time, broke her neck An instance is also given in which strangulation was effected by using the flexible twig of the *dhak* tree, and another one in which strangulation was carried out by placing one bamboo on one side and a second on the other side of the neck and pressing the ends together

Suicidal strangulation with hair

308 Some cases of suicidal strangulation by females with long hair are recorded A remarkable case is given by Chevers* in which an adult male was throttled by Thugs who, after the throttling cut his throat, but he recovered—the cutting of the throat having probably relieved the congestion of the brain and lungs caused by the throttling

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* Medical Jurisprudence for India p 4_5

309 In connection with the subject of suffocation, it should be remembered that there are many diseased states which may bring it about, some rapidly, others slowly. Of such morbid conditions, we may, by way of illustration, mention the following — Suffocation the result of certain diseased states

(a) Bleeding from the nose, or from wounds in the mouth and throat In cases of cut-throat, where the windpipe is jagged or completely divided, a kind of valvular closure effected by the in-drawing of the lower cut end into the throat sometimes occurs

(b) Scalds of the glottis and application of irritants to the fauces or glottis These may produce sufficient œdema of the glottis to cause suffocation (See a case of suffocation from the application of the acid nitrate of mercury to the throat, TAYLOR, Vol II, p 82) Œdema of the glottis may also result from kidney disease

(c) Tumours pressing on the throat or fauces

(d) The bursting of an abscess of the tonsils or of a pharyngeal abscess* (such as occurs in quinsy).

(e) The effusion of lymph or other morbid material into the trachea or about the *rima glottidis*† (*British Medical Journal*, Vol I, 1881, p 386)

(f) An accumulation (often great and rapid) of the bronchial secretion in infantile bronchitis

(g) Acute double pleuritic effusion‡

(h) Simultaneous œdema§ of both lungs

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* A *pharyngeal abscess* is one occurring in the pharynx, usually at the back part of the throat, in front of the vertebræ

† The *rima glottidis* is the chink or opening at the top of the air passages —the *glottis*

‡ An accumulation of fluid (inflammatory or simple serous) in the cavities of both pleural sacs surrounding the lungs

§ "Dropsy of the lungs"

(i) The bursting of an aortic aneurism into the wind pipe or into a bronchus

(j) The bursting of an abscess of the liver into the lung

(k) Very copious and sudden hæmoptysis *

(l) So called pulmonary apoplexy† And here it is to be noted that diphtheria and some other diseases may cause a more or less complete paralysis of the muscles of deglutition (or swallowing), which would predispose to the occurrence of suffocation ‡

Smothering by sand

310 We have on two occasions, seen smothering by sand in the case of workmen on embankments and on the slope of a hill Chevers gives two cases of death by 'drowning in sand' from the falling in of high river banks "The mouths were filled with sand, and the pharynx plastered with it The larynx and the larger bronchi, œsophagus, and in one case the stomach, also contained sand In one case it seemed as though the sand went furthest into the lungs, and in the other case into the stomach and alimentary tract" §

Abnormal causes of smothering

311 An instance is mentioned‖ of a sailor who vomited whilst drunk In vomiting he inspired a lump of half masticated meat, which blocked up the opening into the lungs at the upper part of the neck (*rima glottidis*) We have seen cases in which bread, potatoes—and, in one instance, a piece of guava—produced suffocation Chevers likewise relates the case of a boy who was suffocated from a living fish blocking up the glottis

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* *Hæmoptysis* is the expectoration or coughing up of blood from the air passage

† *Pulmonary apoplexy* is hæmorrhage in the lungs

‡ TIDY's *Legal Medicine* p 451

§ *Medical Jurisprudence for India* pp 419 459 461, 462

‖ CHEVERS's *Medical Jurisprudence for India*, p 617

Case No LXI.—Homicidal Suffocation

The following instances are taken from Chevers :—

One *Lal horu* of Goruckpore was found guilty of rape upon a girl of eight. The child who appeared to understand the nature of an oath declared that the prisoner threw her down and filled her mouth with sand

Case No LXII.—Homicidal Suffocation

A boy was convicted of having robbed a child of four years of age after having filled her mouth with sand and nearly strangled her. The child was found in a field with her mouth full of earth and with the marks of fingers on her neck

Case No LXIII.—Homicidal Suffocation

One *Bhaje ruttee* of Goruckpore was sentenced to death for the murder of a boy of e for his ornaments. He confessed that he had put a cloth in the child's mouth and seizing the throat had choked him

Case No LXIV.—Homicidal Suffocation

Dr Littlewood mentions the case of a woman who was suffocated whilst drunk by forcing a cork into the larynx. The sealed end was uppermost and there were marks of a cork screw in the cork rebutting the defence that the cork had slipped in as the woman was drawing it from the bottle with her teeth. Ribs were also fractured.—(Tidy.)

Case No LXV.—Homicidal Suffocation

Case of *Mary Campbell* killed by Bourke and his companions. Suffocation was caused by pressure on the chest at the same time compressing

the mouth and nostrils with one hand, the other being forcibly applied under the chin At the *post portem*, fifty nine hours after death, the following appearances were observed —Eyes closed and bloodshot Face composed, but somewhat red and swollen Excepting the face, no other lividity Blood issued from the nostrils Tongue normal Slight laceration on the upper lip, opposite the eye tooth florid points *Os hyoides** and thyroid cartilage† more separated than normal but no external injuries apparent Some marks of violence on the limbs

Windpipe —Normal, except that it contained a little tough (not frothy) mucous

Lungs —Normal

Heart —Right side full of black fluid blood

Blood —Black and fluid

Abdominal Viscera —Healthy, except the presence of incipient liver disease

Brain —Slightly turgid Three extravasations on scalp

Effusions of blood on the sheath of the spinal cord, and among the muscles of the neck back, and loins

Injury to the posterior ligamentous connection between the 3rd and 4th cervical vertebræ (This probably occurred after death by doubling up the body)—TIDY

CASE NO LXVI —SUICIDAL SUFFOCATION

TAYLOR cites a case of suicide by a woman who placed herself under the bed clothes and made her child pile numerous articles of furniture on the bed She was found dead some hours afterwards

CASE NO LXVII —SUICIDAL SUFFOCATION

OGSTON speaks of a servant girl who suffocated herself by shutting herself up in a trunk

CASE NO —LXVIII —SWALLOWING A COIN

TIDY, amongst numerous other cases, gives one of a Mr Brunel, who, in 1843, swallowed a half sovereign which became lodged in the right bronchus, and at first caused great dyspnœa For two days afterwards he experienced little inconvenience, but afterwards bad symptoms set in Twenty two days afterwards he was strapped in a prone position on a platform, made moveable on a hinge in the centre, by which means the head was lowered to an angle of about eighty degrees with the horizon When in this position, the back of the chest was struck with the hand, violent choking symptoms resulting Two days afterwards being placed again in this position, tracheotomy was performed, but the attempt to

* The os hyoides is the horse shoe shaped bone situated beneath the tongue

† The thyroid is the prominent cartilage in the middle line of the neck, popularly called Adam's apple

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